International Marine Engineering

Published Monthly by ALDRICH PUBLISHING CO.

17 BATTERY PLACE, NEW YORK — 31 CHRISTOPHER ST., LONDON, E. C.

H. L. Aldrich, President and Treasurer
Assoc. Member of Council, Soc. N. A. and M. E.

George Slate, Vice-President
E. L. Sumner, Secretary

E. J. P. Benn, Director and Publisher
Associate Inst. N. A.

Edited by H. H. Brown, A. M. Inst. N. A.
Member Soc. N. A. and M. E.

Vol. XIX — FEBRUARY, 1914 — No. 2

How the Wireless Works

Explanation of the Various Electrical and Magnetic Effects Taking Place During the Operation of the Instruments

BY J. ANDREW WHITE

There are any number of analogies that may be employed to illustrate the theory of wireless transmission, but none, it would seem, is clearer than the simplest of all. Drop a small stone in a quiet pool of water. A series of wavelets will travel outward in increasingly larger circles. The further they travel the less will be their strength. Now if a chip were floating on the water it would be rocked by each ripple. That is really all there is to it, except that in wireless signaling an electrical power impulse is substituted for the stone, the wave is an invisible one sent through the ether in the air, and the receiving apparatus takes the place of the chip.

The latter point may be made clearer. It is common knowledge that sound travels on invisible waves and registers only on ears that are properly attuned. In other words, sound waves will not impress themselves on the ears of a deaf person, any more than wireless signals will be recorded in apparatus that is not constructed especially for that purpose.

Fig. 1.—Wireless Room of the White Star Liner *Olympic*

With this much in explanation of the theory of wireless signaling, we may pass on to the main purpose of this article: to give a description of the technicalities of a typical set with a simple explanation of the various electrical and magnetic effects taking place during the operation of the instruments. Readers will best be served, perhaps, by confining the explanation to a late type of Marconi set of 1-kilowatt power,

Generated on 2024-08-12 20:26 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

as this apparatus is at present in use aboard a large number of ships.

It is assumed that the reader has some knowledge of elementary electricity and magnetism and is somewhat familiar with the conventionalities of mechanical drawing.

A Typical Wireless Set

Fig. 2 is a complete representation of a Marconi wireless installation, showing all circuits from the direct-current switch up to and including the aerial wires stretched between the masts.

Alternating current is necessary to operate modern wireless sets, and where this is not directly available a motor generator, consisting of a direct-current motor driving an alternating-current dynamo, is used. For compactness both are mounted on the same base and the armatures are usually built on the same shaft. The circuits of one type of machine are clearly indicated to the left of the drawing.

The Direct-Current Motor

The D. C. (direct current) armature consists of a number of coils of wire wound laterally in slots over a soft iron core, the terminals of these windings being connected to the segments of the commutator. The current enters the armature windings through the commutator segments as they pass under the brushes *A* and *B*. The divided circle between the brushes represents the commutator.

The field coil windings of the motor are represented by the spiral wire marked "shunt"; and tracing the conections back it is seen that the terminals are connected across the direct current main line, or in shunt with the armature. The necessary changes of current in the coils of the armature to create changes of flux are made by the commutator.

The Alternating-Current Generator

The alternating-current generator armature is represented by the collector rings marked A. C., and connected to the two terminals of the armature windings. The current is taken from the collector rings through two brushes in sliding contact. Above the generator armature will be seen two field windings, marked "shunt" and "series." The "series" winding is connected in series with the direct-current armature, and the "shunt" winding is in shunt with the direct-current line. This arrangement of the field windings gives a steadier voltage, for when the motor generator slows down under an increased load, and the load is thrown on the generator armature, the direct-current armature requires more current, which causes an increase of current in the series field, because it is connected in series with the direct-current armature. This increase in the series field causes an increase in the magnetic lines of force surrounding the generator armature and a normal voltage is automatically maintained.

The drawing gives the circuits of the rheostat, or starting box, the function of which is to prevent the inrush of current to the windings that would take place if the armature were directly connected to the direct-current mains. The release magnet *R* is connected in series with the shunt field coils as a protection to the motor armature.

Function of the Transformer

When the aerial switch handle is down, and the transmitting key (similar to that used in wire telegraphy) is depressed, alternating currents of low frequency, from 60 to 120 cycles, surge backward and forward through the primary coil of the tansformer. Rising and falling magnetic lines of force are caused by these surgings, and are considerably increased in number by the iron core. These lines of force reverse their direction with the reversals of the current in the coil, and at the same time cut through the secondary winding, inducing in it an electric current of very high pressure or voltage.

In common wireless practice, current at 110 volts is taken into the primary circuit, while the secondary voltage may be 15,000 to 30,000.

Because the current taken in by the primary circuit is at lower voltage than that produced in the secondary circuit this transformer is known as a step-up transformer. It is also known as an open-core transformer, because the magnetic circuit is completed through the air on the outside of the core, in contrast to the closed-core transformer, where the magnetic lines of force have a complete path through the iron.

A voltmeter and ammeter are shown; these respectively indicate the pressure at the terminals of the alternator and measure the current passing through the transformer.

Function of the Condenser

The condenser, or the capacity, is represented at *C* and *C'*, and consists of glass plates covered with tin foil, or, as in this case, glass jars coated inside and outside with copper. In this set there are six jars in parallel in either bank, the two banks being connected in series. This is done to reduce the voltage or pressure on each jar, thereby reducing the chance of puncture. When the condensers become fully charged a discharge takes place across the spark gap, producing an intermittent series of high-frequency electrical oscillations, each one taking place in a very small fraction of a second. The discharge of the condenser takes place through a portion of the primary of the oscillation transformer, the amount of inductance actually in use being determined by the variable contact *F*.

The spark gap acts as a valve, keeping the oscillation circuit idle until the condenser becomes fully charged, then the discharge of the condenser through the spark gap produces high-frequency electrical oscillations.

The circuit, including the condenser, spark gap and the portion of the primary of the oscillation transformer in use, is known as the closed oscillatory circuit, while the circuit, including the aerial, through the secondary helix (a spiral of copper tubing) to the earth, is referred to as the open oscillatory circuit.

Wave Length

As the layman hears a great deal about the wave length of a set, waves varying with the distance to be spanned, it should be noted that circuit-possessing capacity and inductance has a natural time period of oscillation; that is, a certain definite time is required for a complete reversal of current to take place in it. Such a circuit is said to have a definite wave length.

For example, electricity travels at a rate of 300,000,000 meters (186,000 miles) per second, the speed of light. In a wire 100 meters in length a complete oscillation must travel a distance of 200 meters, and the time period of the circuit would be 200/300,000,000, or 1/1,500,000; that is, a complete oscillation takes place in that circuit in 1/1,500,000 of a second. Then it is seen that the circuit oscillates 1,500,000 times per second, and its wave length is 200 meters. Or, in other words, the distance through space traveled by the wave during one complete oscillation or cycle is its wave length. As the wave length of any circuit is determined by the inductance and capacity, if either one is increased the wave length increases.

Changing the Wave Length

Referring to the drawing, if the number of leyden jars, *C* and *C'*, are increased, or if the number of turns of the helix, included by the variable contact *F*, is increased, the wave length is increased, for these are the two factors that determine the time period of the circuit. The wave length of the open circuit is increased or decreased by the helix clip or variable contact *L*, accordingly as more or less turns are included in that circuit. The necessary change of wave length

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

in the closed circuit is secured by means of the variable contact *F*.

When the condensers *C* and *C'* discharge through the helix via contact *F*, what are known for convenience as magnetic lines of force rise and fall about the helix turns of the closed circuit, which not only cut through these turns but interlink with and cut through the turns in the secondary, setting up in it corresponding oscillations of high frequency, which are reflected up and down the aerial wires, producing electrical waves.

For the best working the open and closed circuits must be placed in resonance—they must have the same period or wave length. The oscillation transformer consists of a coil of fixed value of inductance placed immediately above the turns of the closed circuit helix. This coil is supported by the wooden pillars *R* and *R'*, in such manner that the distance between the fixed inductance and the closed circuit helix can be increased or decreased as desired. The function of the oscillation transformer is not only to transfer energy in the form of high-frequency oscillations from the closed to the open circuits, but also to place these two circuits in resonance, and, further, to allow the wave length of either circuit to be increased or decreased as desired.

A separate coil of inductance is connected in series with the secondary of the oscillation transformer and the antennæ (aerial wires), thus enabling the wave length to be varied as desired. This coil is popularly known as the "loading coil."

How the Message is Sent

When the transmitting key is depressed, currents of high frequency traverse the antennæ or aerial circuit, producing around it fields consisting of electrostatic lines of force and electromagnetic lines of force. Owing to the rapidity of the reversals of current these lines of force do not collapse back upon the wire as they do in currents of lower frequencies, but a portion of the energy is radiated into space.

These displacement currents, which take place in space about the antennæ, create electric waves, and it is by means of these, long and short for dashes and dots, that communication between stations is effected.

Auxiliary Sets

Under the recently-enacted wireless laws passenger-carrying ships must be provided with an auxiliary set with an independent power supply. Storage batteries are used, and when a change is made from the power to the auxiliary set (Fig. 2), a flexible cord with a plug contact is connected to the bottom electrode of the anchor spark gap as shown. When it is desired to use the auxiliary set for transmitting this plug is removed from the aerial tuning inductance and

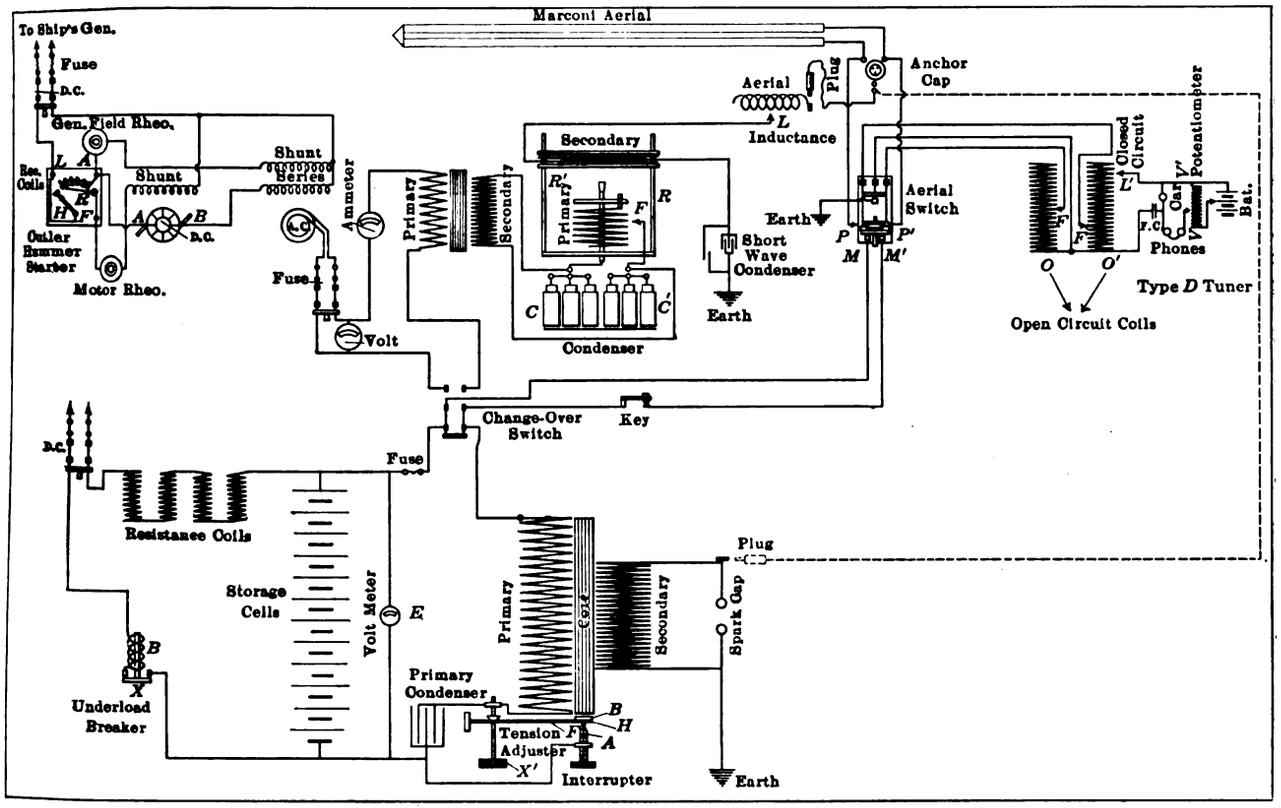


Fig. 2.—Diagrammatic Representation of Complete Marconi Wireless Installation

connected to one terminal of the inductance coil. This arrangement is shown in the drawing. The double-pole, double-throw switch makes the connection to the key on the primary of the induction coil.

The circuits of the auxiliary set are clearly shown in the drawing. The set is essentially divided into three parts: chloride storage cells of the portable type, 8 to 16 in number; a 10-inch induction coil, and a slate switchboard, on which are mounted a direct-current switch with fuses, an underload circuit breaker, a double-pole, double-throw switch, 4 series resistance coils, a battery voltmeter and an enclosed fuse in series with the discharge circuit.

The induction coil consists of a primary winding of coarse wire wound over a soft iron core (marked primary) covered with an insulating tube, over which is wound a great number of turns of very fine wire (marked secondary). Both are wound around the iron core, but for clearness the drawing shows the core between the two windings. The interrupter in the primary circuit is indicated by the spring *F*, on which is mounted a piece of soft iron *B*. A platinum contact is fastened to spring *F*. The circuit through the primary is completed through the adjustable platinum contact *A*. On its normal position the spring *F* causes the platinum points to be in electrical contact with one another.

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

When the double-pole, double-throw switch is in the position shown, the aerial switch pressed down and the transmitting key depressed, current from the storage cells enters the primary coil via contacts *H* and *A*, the magnetic field thus produced being augmented by the presence of the iron core. Immediately the core becomes magnetized it attracts the small piece of iron *B*, which opens the contacts *H* and *A*, interrupting the primary circuit. As the current has stopped there are no magnetic lines of force to hold the spring and it flies back again, closing the circuit through *H* and *A*. This process is repeated several times per second, resulting in the production of rising and falling magnetic lines of force, which intersect and cut through the turns of fine wire in the secondary winding, inducing currents of very high potential or voltage.

A condenser of large capacity is connected directly across the break of the interrupter. This not only serves to eliminate the spark at the interrupter contacts, but also assists in demagnetizing the core after each break of the circuit; thus a more rapid change of magnetic flux in the primary core is secured, giving a greater effective current in the secondary windings. The terminals of the coil are connected directly to the spark gap, which is also connected in series with the antennæ. Since the antennæ possesses capacity in respect to the earth it is capable of being charged, and when the high potential surgings are produced in the secondary of the coil, an electrostatic charge is maintained on the aerial, which finally becomes of such value that a discharge takes place across the spark gap, producing high-frequency oscillations. The surgings produced by these oscillations result in the production of the electromagnetic waves that represent the code message.

Receiving Apparatus

Having considered the details of the transmitter the receiving apparatus may be dealt with briefly, as it is in many points similar to the sending station and uses the same aerial.

It has been explained that the transmitter emits signals in the form of waves of definite lengths and characteristics according to adjustment of the apparatus, and that these waves travel in all directions with the speed of light. To receive these all that is necessary is apparatus which will detect the waves as they strike the receiving aerial and make them intelligible. The receiving apparatus, then, includes a detector to rectify the incoming oscillations, sensitive recorders in the form of telephone receivers, and various inductive and capacity apparatus to attune the station to the wave length of the signals desired and to exclude undesired signals.

When receiving, the aerial switch is lifted up, the primary of the transformer circuit is disconnected, and the receiving apparatus is connected both to the aerial and the earth.

While the detector is not of itself the most sensitive instrument, it is essential because the telephone receiver, to respond to the rapid high-frequency oscillations, would have to possess a diaphragm that would move with a frequency corresponding to approximately one-millionth of a second, which, of course, it cannot do. Therefore the function of the detector is to translate the received oscillations into a current which will operate the receiver. The detector is simply a small piece of crystal mounted between a large and small contact.

Tuning the Circuits of the Transmitter and Receiver

In order to receive signals the receiver must be adjusted until its circuits are attuned to or in resonance with those of the transmitter; for example, if a station is sending out a 600-meter wave the receiver must be adjusted until its wave length is 600 meters, or very nearly so.

The receiving tuner represented is known as type *D*, and by referring to the drawing it will be noted that the aerial is split in two leads brought to the receiving apparatus. As in transmitting circuits the receiving apparatus has both open and closed circuits. The open circuit is represented by coils *O* and *O'*. The wave length of the open circuit is varied by contacts *F* and *F'*. A closed oscillatory circuit is bridged around one of these coils, and the inductance included in that circuit is varied by means of the sliding contact *L'*.

The closed oscillatory circuit includes the carborundum crystal (*CAR*), the fixed condenser (*FC*), and whatever amount of inductance is used as determined by contact *L'*.

The coil to the left of the tuner is the one on which the principal change of wave lengths is made. The action of the tuner is as follows:

When the two coils *O* and *O'* are connected to the antennæ circuit by means of the aerial switch, and the sliders *F* and *F'* properly adjusted to secure resonance, high-frequency oscillations traverse these coils. Those produced in coil *O'* set up magnetic lines of force, which interlink with the adjacent turns of the secondary, setting up counter electromotive force, which passes through the closed oscillatory circuit, including the detector.

A small battery current flowing through the crystal increases its sensitiveness, and because different values of current are required for different crystals a device known as a potentiometer is used. This is indicated in the drawing.

The potentiometer is a variable resistance connected in shunt to the battery, and may be inductive or non-inductive. In this case it consists of a number of carbon resistance rods, connected to a variable point switch in such a manner that the resistance can easily be adjusted. This is done by means of the sliding contact *V'*, which, when moved toward *V''*, decreases the current flowing through the head telephones and detector, while a rapid increase in current takes place as the contact is moved away from *V''*. In this way the current is adjusted until the detector reaches its maximum degree of sensitiveness.

While page after page could be covered with explanation of the phenomena encountered in wireless operation, careful study of the drawing and a second reading of this article should be sufficient to give those who are interested a fair working knowledge of how wireless signals are received and transmitted.

Many of those who have been shipmates with wireless, but knew little or nothing of its working, will find a new and interesting field for observation if the drawing and explanation are compared with a regular commercial equipment while the operator points out the various devices.

Half-Yearly Shipbuilding Returns.—The Bureau of Navigation reports 644 sailing, steam and unrigged vessels of 163,849 gross tons built in the United States and officially numbered during the six months ended Dec. 31, 1913. Of these, 53 were steel steam vessels aggregating 93,224 gross tons. The total gross tonnage built during this period was practically the same as that for the corresponding period in 1912, when 791 vessels aggregating 163,584 gross tons were built. The tonnage of steel steam vessels built during the last six months in 1913, however, was somewhat greater than that built in the last six months in 1912, the figures being 93,224 and 89,364, respectively. The tonnage of steel steamships built on the Atlantic coast during this period in 1913 was 16 percent greater than in the same period in 1912, while on the Great Lakes there was a decrease of nearly 30 percent. On the Pacific Coast about the same tonnage of steel steamships was produced in the last six months of both 1912 and 1913.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 87 sailing, steam and unrigged vessels of 22,881 gross tons built in the United States and officially numbered during the month of December, 1913. The largest vessel completed during the month was the *Manoa* of 6,203 gross tons, built for the Matson Navigation Company by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va.

Generated on 2024-08-12 20:33 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Change of Shape of Recent Colliers*

Results of Observations of Hogging and Sagging on 500-Foot Naval Colliers—Motion of Tank Top with Reference to the Upper Deck

BY NAVAL CONSTRUCTOR STUART FARRAR SMITH, U. S. N.

That ships bend in the middle has, of course, been well known for generations; and the tendency of wooden ships to hog was so well known that their keels were laid to a curve, which, it was judged from experience, would be approximately straightened out after they were afloat. The old records of the Bureau of Construction and Repair contain much interesting information as to the allowance for hogging in the case of our old wooden sailing and steam vessels, as well as information as to the changes in shape due to launching and loading.

But with the introduction of iron and steel vessels, at first of short length and heavy scantlings, the changes in shape were so slight that they were practically neglected. At the same time the importance of calculating the strength of these comparatively new structures was brought to the notice of designers and the present strength diagram was developed. As the ships grew longer it was apparent that weight could be saved if the superstructures were not built to resist the stresses arising in the upper part of the girder; hence arose the expansion joint in long deck houses on passenger steamers which has brought itself loudly to the attention of the unfortunate landlubbers whose staterooms were near it.

It has, therefore, been known for many years that steel ships worked, but the subject of observing the amount of flexion and from that deducing the stresses to see how they compared with the results provided for as a result of the strength diagram, does not seem to have been investigated in proportion to its importance, or to the opportunities which exist for obtaining data.

The observations which are here presented to the society are not as complete as they should be, and consequently only rough deductions can be made. This is partly because as the observations were made it appeared that additional data of different sorts should have been taken. In other words, hindsight was clearer than foresight, and if the observations were to be repeated a good deal more could be learned with very little additional trouble.

Crude as they are, it is hoped that the results may interest some of us enough to make similar observations in such form that strength calculations can be checked, and possibly our designs improved.

The loss of the *Cobra* and *Viper* in England led to an elaborate series of tests on one of the British destroyers. Observations more or less extensive have been made on several of our destroyers, and it is common practice to erect battens or take sights before launching so that any great change in shape when afloat can be ascertained; but these observations have been based largely on the idea that a steel ship does not change much, and that if much change of shape occurs something is wrong. It would probably surprise a good many owners to learn that a 500-foot ship can bend over 6 inches due to loading and be none the worse for it; also to know that a rise in temperature of only 7 degrees may change the shape by an inch.

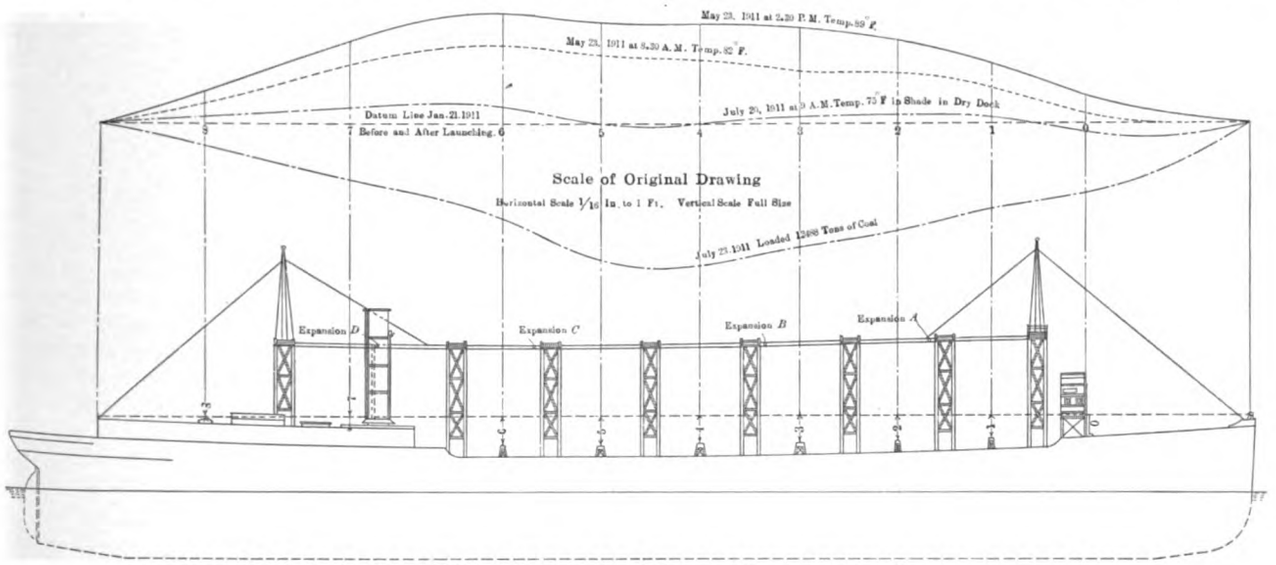

May 23, 1911 at 2.30 P.M. Temp. 89° F.
May 23, 1911 at 8.30 A.M. Temp. 82° F.
July 26, 1911 at 9 A.M. Temp. 75° F. in Shade in Dry Dock
Datum Line Jan. 21, 1911
Before and After Launching
Scale of Original Drawing
Horizontal Scale 1/16 In. to 1 Ft. Vertical Scale Full Size
July 23, 1911 Loaded 12888 Tons of Coal
Expansion D
Expansion C
Expansion B
Expansion A

Fig. 1.—U. S. Collier *Neptune*, Curves Showing Hogging and Sagging

The amount of change in shape in the keel line of battleships is another matter which is not as fully realized as it ought to be, especially in the case of the new ships with several turrets, and I hope that some one of the members of the society who is in possession of the data will take the trouble to give us the results found by comparing the alinement of turret roller paths afloat and in dry dock.

The observations plotted on Figs. 1, 2 and 3 were taken on the colliers built for the navy by the Maryland Steel Company at Sparrow's Point—the *Neptune, Orion* and *Jason*. The last two were sister ships, built on what is generally known as the Isherwood system, while the first was similar but slightly longer and built with transverse framing.

The *Neptune* was the first ship built and shows considerably more change of shape than the two ships with longitudinal framing, having a maximum of 6½ inches against less than 5 inches for the *Jason* and only 3⅜ inches for the *Orion*. In this statement I omit the *Jason's* condition of April 3, 1913,

*A paper read before the Society of Naval Architects and Marine Engineers, New York, December, 1913.

Generated on 2024-08-12 20:26 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

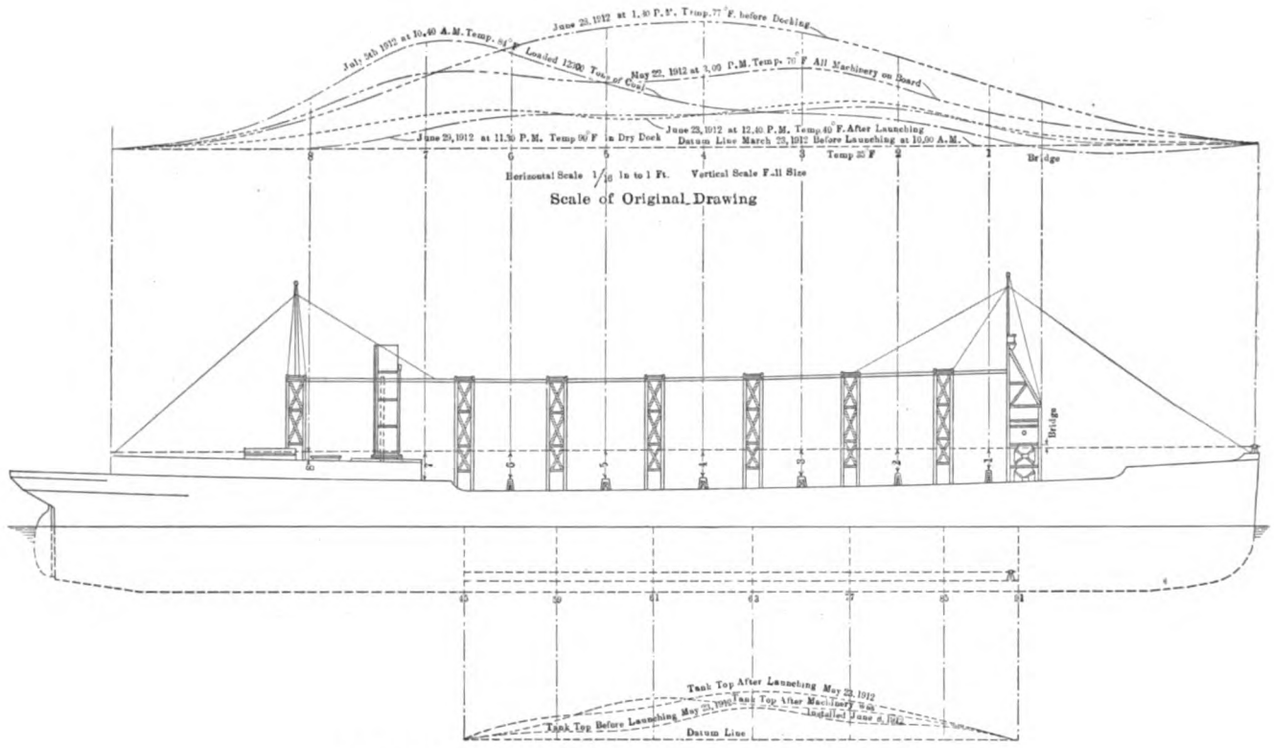


Fig. 2.—U. S. Collier *Orion*, Curves Showing Hogging and Sagging

as she was at that time damaged due to a dynamite explosion on a vessel lying near her.

The sister ships show surprisingly different results. The *Orion* showed considerable hogging immediately after launching, while the *Jason*, like the *Neptune*, remained nearly straight. Moreover, the *Orion* when loaded showed no sagging, but the point of maximum hogging simply moved aft somewhat as if her cargo had rolled her "hump" toward the stern. The *Jason*, on the other hand, behaved like the transverse-framed *Neptune* and changed from slight hogging when light, to a considerable sag when loaded. The cause may lie in the difference in the tank tops, as I shall explain.

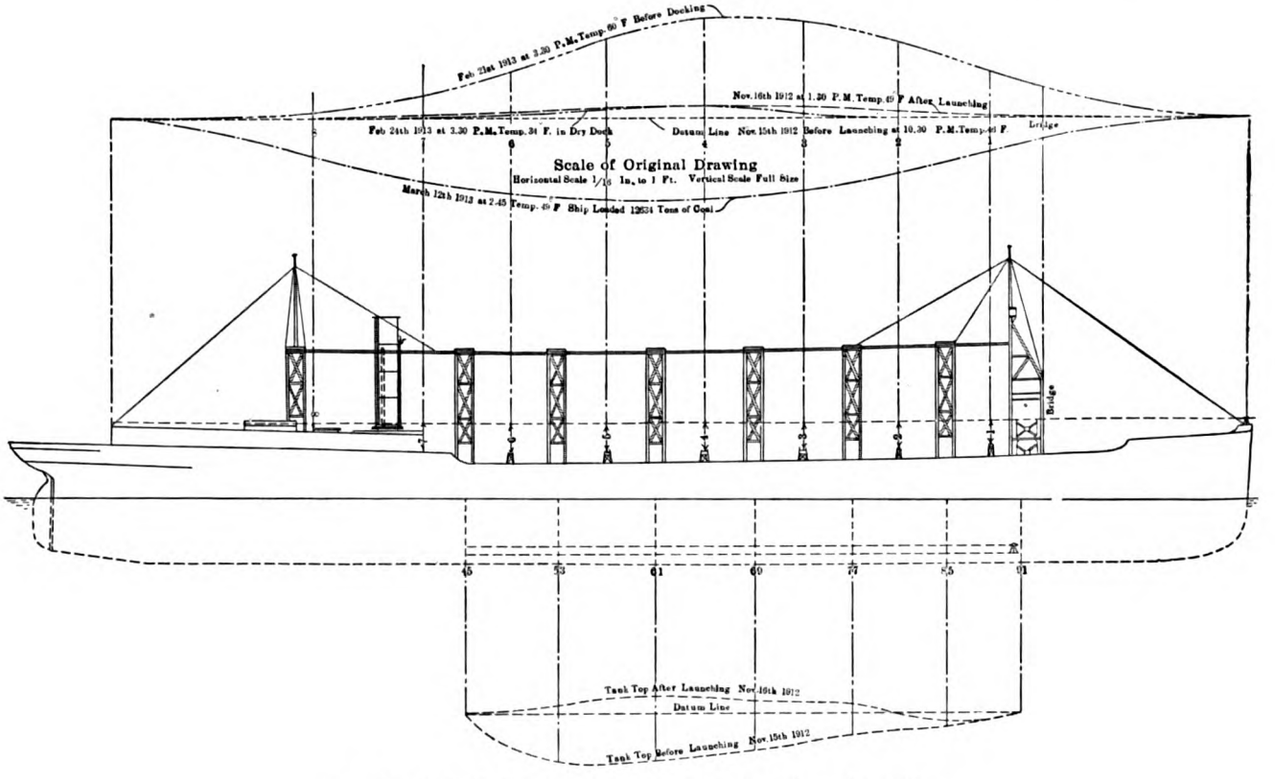

Scale of Original Drawing
Bridge
Tank Top After Launching Nov. 16th 1912
Datum Line
Tank Top Before Launching Nov. 15th 1912

Fig. 3.—U. S. Collier *Jason*, Curves Showing Hogging and Sagging

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

After the observations had been made on the *Neptune*, the question arose: "If a ship bends, that is, if the main deck is forced up or down, what happens to the bottom?" As a result of this, on the two later vessels sights were taken through openings left near the foot of each bulkhead in the cargo holds. Observations of the height of the sight line above tank tops are plotted in Figs. 2 and 3; these show that the *Orion's* tank top was convex, while the *Jason's* was concave before launching. As all three of these vessels were built on the same ways, it is unlikely that the blocks settled so differently, and it is therefore probable that the curve in the tank top was due to slight structural unfairness. The intial convexity in the *Orion*, which remained even when loaded, would seem a desirable thing, as it apparently resulted in reducing considerably the maximum change of shape, and may have acted to a small extent after the manner of an arch.

Another point, although to be expected, is that none of these ships came back to its original shape when docked.

In connection with the tank top curves, it should be noted that while the deck of the *Jason* at Station No. 5 went up only 5/16 inch after launching, the tank top immediately below was forced up 1⅝ inches. On the *Orion*, where there was an initial convexity of the tank top, it rose 13/16 inch, while the deck at Station No. 5 rose ¾ inch.

As originally planned on the *Neptune*, there were no stations for sights aft of the cargo holds. Just before completion it was decided to establish Stations Nos. 7 and 8, and readings were taken at the last two sets of observations, but as they did not materially alter the curve, these additional stations were omitted on the later vessels.

Of these colliers, only the *Neptune* had expansion joints in the track for handling coal fore and aft, and on her some observations were taken to make sure that the joints allowed sufficient play to relieve the track from undue longitudinal stress. The readings show that for an increase of sag of about 3 inches there was no motion at all in the joints. The first set of readings were taken without reference to the question of change in shape of the hull, but as the ship was substantially in the same state on May 23 as on June 14, it will be seen that in changing from maximum hog to maximum sag practically no motion took place in the joints.

In the case of each of the three ships, the change in shape due to fitting out after launching is obscured by the rising temperature, which produced a hog; while the effect of the former is not clear, some light is thrown on this by the tank top curve in the case of the *Orion*, which shows that putting in the machinery reduced the hog of the tank top, although, owing to much higher temperature, the hog of the upper deck had been considerably increased.

As regards change in shape due to temperature alone, none of the observations on either the *Orion* or the *Jason* afforded any good comparison. In the case of the latter, there are, it is true, two observations made at different times with the ship complete, but the conditions of loading, etc., as indicated by drafts, show that these cannot properly be compared with one another. This lack of ability to compare the temperature effects is the more regrettable, as it was on these two ships that tank top readings were possible.

On the *Neptune*, however, two sets of readings were taken on the same day and under the same conditions of loading. The ship was very nearly complete, and if tank top readings had been possible the result would have been even more valuable. These observations show that for a rise of temperature of 7 degrees F. the maximum hogging increased 1 inch, while the two curves (Fig. 1) show that the effect was fairly uniform throughout the length of the vessel.

The method of taking sights was very simple. A transit instrument mounted on a special short-legged stand was placed on a breast hook at the stem head, its center being located over a punch mark on the plate of the breast hook. The transit was sighted on a permanent target located at the after end of the deck house, and the heights were observed by a measuring rod held vertically on each of the hatch cover supports, which were used as the observing stations.

Fig. 4 shows curves from some observations made on the collier *Nereus*, built by the Newport News Shipbuilding and Dry Dock Company, and though the method of observing was somewhat different, and the resulting curves were differently plotted ,a comparison with the other vessels is interesting.

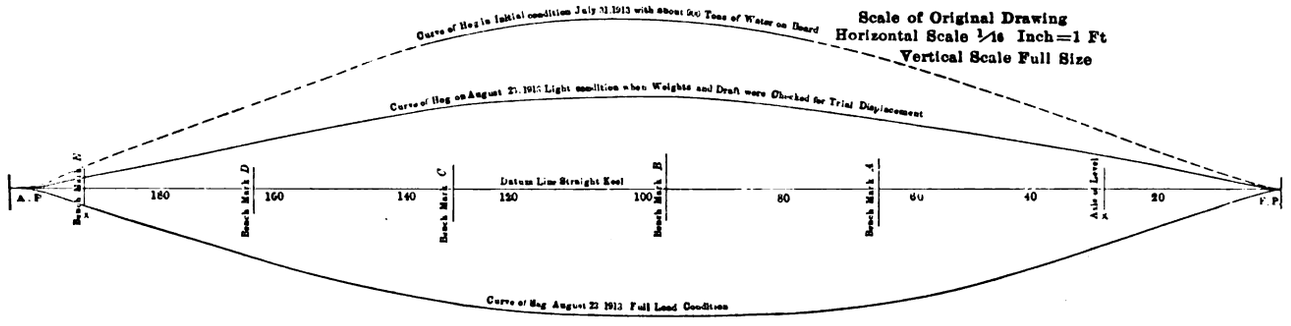


Fig. 4.—*Nereus*. Curves of Hogging and Sagging

The *Nereus* is in general similar to the *Orion* and *Jason*, except that she is 10 feet shorter and is built with the ordinary transverse framing. No sights were taken before launching, but a line was run when the vessel was practically complete. A second set of sights was taken in dock, and on the assumption that she had straightened out, this latter set was then used as establishing the datum line; and the curves shown on Fig. 4 were plotted for hog and sag, although all the readings were taken as sag.

In conclusion, I wish to express my obligations to Mr. T. M. Cornbrooks, chief engineer of the marine department of the Maryland Steel Company, as it is largely due to the interest in this matter taken by him and by his assistants that these observations were made.

LLOYD'S SHIPBUILDING RETURNS.—According to returns compiled by Lloyd's Register of Shipping, which take into account only vessels the construction of which has actually begun, there were, excluding warships, 513 vessels of 1,956,606 gross tons under construction in the United Kingdom at the close of the quarter ended Dec. 31, 1913. The tonnage now under construction is about 30,000 less than that which was in hand at the end of the last quarter, and about 13,000 tons less than that building in December, 1912. Of the vessels under construction in the United Kingdom at the end of December, 420 of 1,557,551 gross tons were under the inspection of Lloyd's surveyors with a view to classification by the society. In addition 116 vessels of 497,976 tons are building in other countries under Lloyd's survey, making a total of 536 vessels of 2,055,527 tons now building under the supervision of Lloyd's Register.

Generated on 2024-08-12 20:26 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Four 250-Ton Giant Cranes Now Under Construction for Use in Shipyards

In the same degree as the dimensions of mercantile and war vessels increase, the shipyard equipment, such as building berths, floating and wharf cranes have to become more powerful and efficient. Cranes of 150 tons capacity, which were considered amply large enough only a few years ago, prove insufficient for handling the heavy machinery parts, turrets, etc., which enter into the construction of modern ships. Also the outreaches of these cranes have to be increased, owing to the increase in the width of the boats. Under these conditions leading German shipyards find it necessary to add to their equipment cranes of 250 tons capacity.

In the October issue of 1913 we gave a description of the new 250-ton wharf crane for Blohm & Voss at Hamburg. At present the Deutsche Maschinenfabrik at Duisburg, represented in New York by Neumeyer & Dimond, has under construction, besides the two 250-ton floating cranes for the Isthmian Canal Commission, a 250-ton revolving floating crane for the Imperial Navy Yard at Wilhelmshaven, and a 250-ton wharf crane of the hammer type for the Shipyard Schichau at Danzig.

The 250-ton wharf crane for the Schichau Shipyard is similar in design to the one shown in Fig. 1. It was originally ordered for a capacity of 200 tons, but during construction it was decided to increase the capacity to 250 tons. It is equipped with one 250-ton trolley and one 50-ton trolley, both running on the same track inside of the long arm of the jib. A revolving traveling crane runs on the top chord over the entire length of the jib and has two hooks of 20 and 5 tons capacity, respectively. The top chord of the jib is 187 feet above the wharf and its entire length is about 320 feet. The importance of the revolving traveling crane on top of the large crane has been discussed on page 438 of the October, 1913, issue of this paper and is well illustrated by Fig. 1, showing the setting of a mast.

The crane is electrically driven throughout. The maximum load of 250 tons can be lifted at a distance of 105 feet from the center of the crane, or 74 feet from the edge of the quay wall. The 50-ton trolley is principally used for attaching armor plates and it can handle the full load at a distance of 180 feet from the center. The five-ton hook of the auxiliary crane has a radius of 33 feet and can take up loads at 216 feet from the center of the crane, covering an area of 3.3 acres in a full revolution of the big crane. The operator's cabin is about 160 feet above water level and the entire crane is controlled by one man.

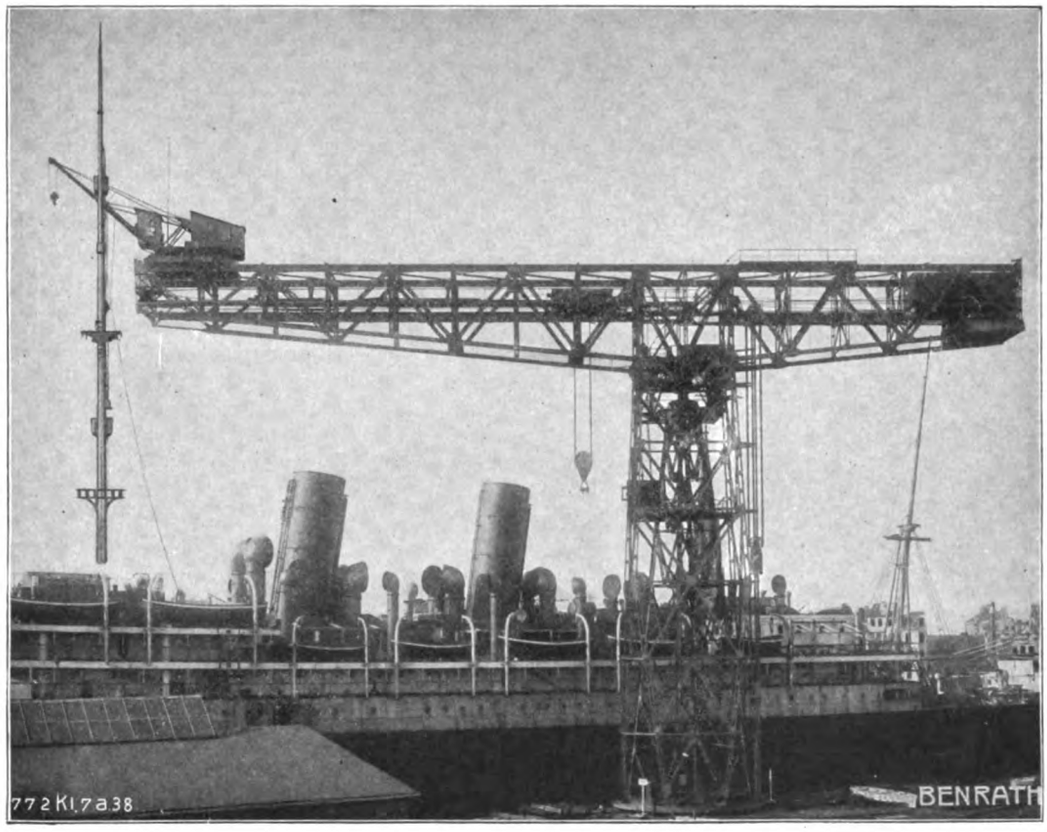


Fig. 1.—Wharf Crane of Hammer Head Type

The floating crane for Wilhelmshaven is of the same type as the cranes for Panama, which are similar in design to the crane illustrated in Fig. 2, but it has a larger outreach and several additional hooks. It can lift the maximum load of 250 tons at a distance of 59 feet from the fender over three sides of the rectangular pontoon, whereas the outreach of the Panama cranes under the same conditions is only 24.5 feet. The pontoon has a beam of 100 feet and can carry a deck load of 500 tons. While the Panama cranes have two 125-ton hooks at the end of the jib and a 15-ton climbing trolley, the new crane carries a 50-ton hook at the end of the jib, two 125-ton hooks about 40 feet below same, a 20-ton climbing trolley and a 10-ton hook alongside of each one of the two large hooks. The 10-ton hooks are used mainly for handling the chains and slings when attaching and detaching heavy loads to and from the big hooks. Loads of 50 tons can be raised at a clear reach of 130 feet over the fender.

The hoisting, luffing and revolving motions are driven by direct current electric motors, which receive their current from two generating sets, each driven by a steam turbine located in the pontoon. One set is for reserve. The current for the electric light and for exciting the motors is furnished by a

Generated on 2024-08-12 20:32 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

separate steam-driven unit and provision is made that this current can be supplied from land also.

The entire controlling apparatus is placed in the operator's cabin below the pivot of the jib, about 65 feet above the water

Fig. 2.—Floating Crane

level. The machinery of the crane is attached to the lower end of the revolving part of the crane structure.

Unlike the Panama cranes, which have to be towed, the new crane is self-propelled by two screws, each driven by a 500 horsepower triple-expansion steam engine.

Collier Hampden

The New York Shipbuilding Company, Camden, N. J., is now building for the Coastwise Transportation Company, Boston, Mass., a steel screw collier of the following dimensions:

Length between perpendiculars	377 feet 4 inches
Beam, molded	50 feet
Depth, molded	32 feet
Draft, loaded	25 feet
Gross tonnage	4,727 tons
Speed at sea, loaded	10 knots

The vessel is of the same type as the *Coastwise, Transportation, Suffolk, Norfolk* and *Middlesex*, built by the New York Shipbuilding Company for the same owners during the last four years, although the dimensions and deadweight have been increased. The construction is in accordance with the requirements of Lloyd's Register.

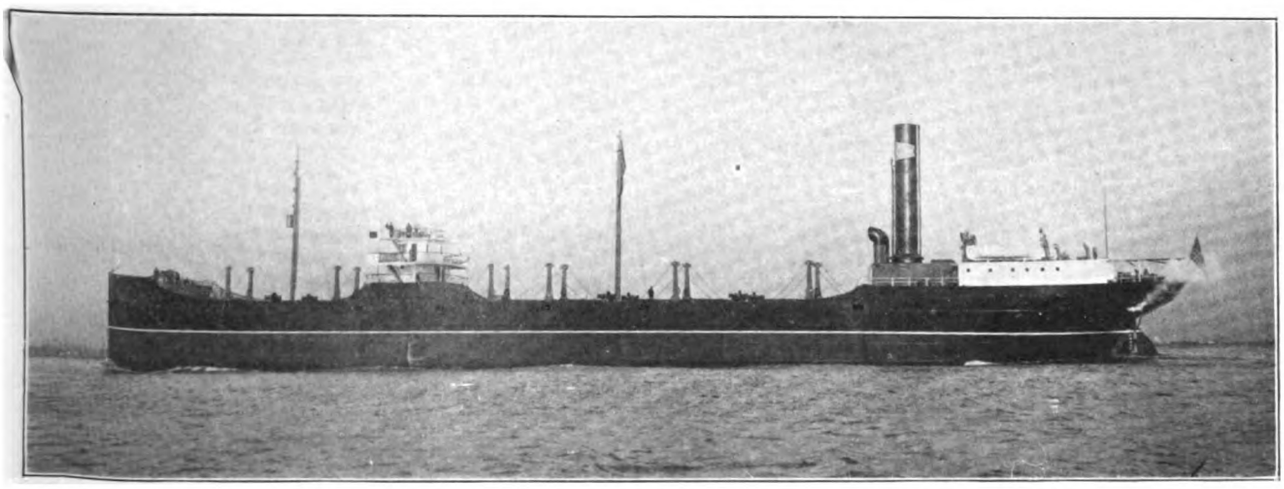
Hull Construction

The vessel has a single deck of steel, with poop 80 feet, bridge 17 feet and forecastle 34 feet long, eight steel watertight bulkheads, two pole masts, a straight stem and semi-elliptical stern. A deep double bottom is fitted all fore and aft for the carriage of water ballast. Particular attention has been paid to the construction of this part of the vessel; the plating is of extra strength and fitted flush; no wood ceiling is fitted. Water ballast is also carried in a deep tank amidships.

The five cargo holds are entirely clear of beams and pillars, the deck being supported by deep arched beams and web frames fitted midway between the watertight bulkheads.

A continuous trunk 24 inches deep by 30 feet wide is carried on the upper deck for the full length of the cargo spaces, the sides forming strength girders between the bulkheads. Large steel cargo hatches are fitted on top of this trunk, eleven in all, three to the main hold and two to each of the other holds. Six steam winches are fitted in connection with six pairs of king posts for raising the hatch covers and securing them in place when open. A cargo boom is fitted on the foremast for handling stores, etc.

The coal bunkers are at the sides of the vessel in the boiler room and in the poop 'tween decks, with hatches on the poop deck and pockets leading to the fireroom. The peaks are both fitted as water ballast tanks.



Collier *Hampden*, Built by the New York Shipbuilding Co. for the Coastwise Transportation Co.

Generated on 2024-08-12 20:32 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

ACCOMMODATIONS

The accommodations consist of a midship deckhouse on the bridge deck for the captain's stateroom and spare room, with a pilot house over; the saloon, officers' and petty officers' berths, pantry, toilet, etc., are in the bridge; the engineers', cooks', steward's messroom, refrigerator, toilets, galley, etc., are in the house on the poop deck, and the oilers, seamen and firemen are berthed in the poop abreast the engine casing.

DECK AND PROPELLING MACHINERY

A steam windlass is fitted forward with the wildcats and warping ends on the forecastle deck and the engine below in the forecastle. A steam capstan is fitted on the after end of the poop deck, with the engine below. The steam steering gear is fitted on the upper deck abaft the engine casing with connection to the steering stations in the pilot house and on the navigating bridge; an auxiliary hand screw gear being fitted to the crosshead on the rudder stock on the upper deck.

The propelling machinery is placed aft and consists of one triple-expansion inverted reciprocating engine of about 2100 indicated horsepower and two single-ended Scotch boilers have a working pressure of 185 pounds.

The vessel is intended for the coastwise coal-carrying trade. Loading and discharging gear is not fitted on board, the two terminal points being arranged with these facilities. The vessel was launched Dec. 15.

Power Limitations of the Marine Gasolene (Petrol) Engine

BY ALBERT H. ZIEGLER

An investigation of several of the largest sizes of gasolene (petrol) marine engines ever built and installed in America, produces abundant evidence of almost infinite careful attention in every detail to all the conditions and functions affecting maximum efficiency and low fuel consumption, and indicates that after having had about ten or twelve years of practical experience in the application of the larger sea-going, heavy-duty gasolene (petrol) engines to the mercantile, yachting and high-speed naval fields, America has produced a type of engine which to-day represents, in all probability, the maximum aggregate of all the important practical advantages and operating qualifications over steam installations that may ever be looked forward to in any marine engine consuming so costly a fuel as gasolene (petrol). As regards any further material reduction of fuel consumption per brake-horsepower per hour, present achievements along such lines in the properly designed and constructed modern gasolene (petrol) marine engine leave little or nothing to be hoped for.

The engines investigated were of the double-acting type, the total percentage of mechanical friction loss per unit of power delivered to the shaft being considerably less, and the mechanical efficiency being therefore higher than is the case in single-acting marine engines. The delivered or shaft-horsepower of the engines considered was about 89 percent of the indicated horsepower at full load.

In these engines the compression was 84 pounds gage pressure, all that a marine engine of their size, operating at full load practically all of the time, under medium heavy-duty conditions could stand, to insure reliability of operation, freedom from overheated valves, and pre-ignition. The piston-speed was 750 feet per minute.

All inlet valves and valve passage areas were sufficiently large, and of such form as to secure the admission of the carburetted charge at a full load inlet pipe vacuum not exceeding one-half pound gage pressure, thus relieving the pistons from acting against any unnecessary retarding vacuum during the whole of each suction stroke, work that, once done, is never regained nor justified in any gasolene (petrol) engine.

The charges were taken into the cylinders at a temperature considerably lower than that of the outside air, due to the refrigerating effect of the evaporation of the gasolene (petrol), insuring a contracted or denser charge. This, together with the very slight attentuation of the incoming charges, due to the unusually low inlet pipe vacuum, insured a remarkably high volumetric efficiency in the cylinders, a very large charge of high density, and producing a high mean effective pressure, therefore requiring a proportionately smaller engine for producing the required power, with less friction loss than a higher degree of inlet pipe vacuum and a heated and expanded charge would have occasioned.

The lessened velocity and fluid friction of the incoming gases, due to the large areas, carefully designed passage forms and the low in-take pipe vacuum, also aided materially in the high degree of efficiency attained. The exhaust valves and passages were of the same areas as for the in-take.

A large exhaust manifold, having an internal diameter almost equal to the cylinder diameter and long enough over all to include all cylinders, forming in effect a large exhaust expansion chamber, was placed within a few inches of all exhaust valve seats. All cylinders exhausted into this chamber, one at a time, in their proper sequence, the ends of all exhaust passages projecting into the chamber in the form of hoods or cowls, and so arranged as to cause the high-pressure, high-velocity gases of any one cylinder, the exhaust valve of which was just beginning to open, to set up a strong ejector action on the hood of the previously exhausting cylinder, the exhaust valve of which was nearly closed. This ejector action not only positively relieved all back pressure on the pistons during the exhaust stroke in all cylinders, but also set up within the cylinders a slight degree of vacuum which, acting on the next incoming charge, helped overcome the inertia due to starting the gas to flow into the cylinders, and resulted in a somewhat increased volumetric efficiency, higher mean effective pressure, and therefore higher mechanical efficiency. The exhaust pipe from this manifold to the outside air was of such a diameter as to produce a mean gas velocity through it of not over 70 feet per second.

The carburetor was of special design, operating uniformly at the one-half-pound vacuum, from no load to full load, and securing a most thorough atomization of all gasolene (petrol) passing through a nest of nozzles or spray tubes, this finely sprayed gasolene (petrol) being very intimately intermixed with the incoming air charges, and the in-take pipe above the carburetor being sufficiently hot-water jacketed to prevent the condensation of the gasolene (petrol) vapor on the walls of the inlet pipe and passages, but not appreciably heating the center of the charge. The mixture was run very lean, being only rich enough to prevent back-firing through the inlet pipe and carburetor.

Double ignition in each cylinder, both sparking exactly simultaneously at all speeds, was employed, the plugs giving an extra large and "fat" arc flame, which combined features secured very rapid flame propagation and reduced the ignition lead required at full load, high speed, to less than 16 degrees.

During the fuel consumption tests the engines were run at maximum load, and the cooling water was heated to 165 degrees F. The crankshaft was made to allow a constant circulation of cold water throughout its entire length, and all bearings on the engine were given an abundant supply of oil. Though the expanse of water-jacketed surface in the combustion spaces was rather generous, it was found on actual test and comparison that a sufficient increase of compression was thereby obtained to more than offset the slightly excessive water-jacket heat losses.

The final result of the above refinements in these engines is a strong indication that it would be impractical to expect, under ordinary conditions of operation, and with the grades of gasolene (petrol) now commercially available in large quanti-

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

ties, a lower fuel consumption for marine engines than was obtained in these instances; namely, .1124 gallon, or .9 pint, or by weight, .64 pound of gasolene (petrol), of about .683 specific gravity, 75 degrees Baumé (weighing 5.69 pounds per gallon) per brake-horsepower.

The modern large marine gasolene (petrol) engine, such as above described, for application in the workaday mercantile, yachting and high-speed naval craft, if fuel cost is not considered, has proved its many practical advantages over steam installations as regards total first cost, weight involved, space required, and simplicity of propelling machinery with its auxiliaries and accessories, making necessary therefore either a smaller hull requiring less power to drive it at any definite speed and for a definite accommodation capacity, or else producing a higher speed with greater space available for cargo or passenger accommodations in any definite sized hull. The engine rooms are cooler and fresher, there are no fiery stokeholds, refueling is infinitely easier, cleaner, quieter and more quickly accomplished. The cruising radius is about doubled for a definite weight of fuel supply, practically no time is required for preparations for getting under way or for laying up after a run, no fuel is consumed when the boat is not running, there is no banking of the fires to be attended to, no government boiler inspection, no boiler scale and flue cleaning; also there is a considerable reduction in the crew required, as well as in the involved crew's quarters, wages and feeding requirements.

Such engines have also proved their general reliability of operation, proper adaptability, flexibility of speed and power control, accessibility for inspection and repair, long life and direct reversibility, without recourse to planetary reverse gearing. They are also capable of starting and stopping almost instantaneously in either the ahead or the astern motion, and as many times in succession as may be required in maneuvering about any crowded harbor.

Though a very great deal still remains to be done regarding lessening of the cost of production, simplification of mechanical detail, standardization of design and construction, consistent with each class of marine service, and in disseminating a more thorough appreciation and knowledge of the importance of a more rigid adherence to a policy absolutely requiring a correct selection of the proper weight, rotative speed and type of engine for each class of marine service, yet the future developments of the internal-combustion marine engine are likely to do very little, in America at least, toward bringing about the ultimate general adoption in the larger sizes of that form of propelling engine in preference to the steam installation properly equipped, until internal-combustion marine engines are eminently able to operate on a very much cheaper and more abundant supply of fuel than gasolene (petrol).

An investigation of the performances of such sizes and types of gasolene (petrol) engines as are more or less common to the heavy-duty, deep-sea class of marine service in American waters, covering both the builder's test-stand records and the log records of various types and tonnages of craft where such engines are installed, produces the following mean results as to gasolene (petrol) consumption and fuel cost per brake-horsepower per hour, the gasolene (petrol) used being 68 degrees Baumé, .707 specific gravity, weighing 5.81 pounds per gallon, and costing 11 cents (0/5½) per gallon in 500-gallon lots in and around New York Bay:

Per B. H. P. Hour	75 H. P.	150 H. P.	300 H. P.	700 H. P. Double Act'g
Gallons	.1225	.1210	.1200	.1125
Pints	.981	.970	.962	.900
Pounds	.722	.714	.707	.664
Cost	1.347c.	1.33c.	1.32c.	1.237c.
	.674d.	.67d.	.66d.	.610d.

From which it is evident that the fuel cost per brake-horsepower-hour does not vary much for large and small-sized units.

For the same fuel costs per brake-horsepower-hour, coal at $3.25 (13/6½) per ton of 2,000 pounds, steam installations of similar powers would have to consume coal to the following amounts:

Per B. H. P. Hour	75 H. P.	150 H. P.	300 H. P.	700 H. P.
Cost	1.347c.	1.33c.	1.32c.	1.237c.
	.674d.	.67d.	.66d.	.619d.
Pounds used...	8.3	8.18	8.12	7.61

In most representative practice the consumption of coal per brake-horsepower-hour for steam installations of like powers, with the auxiliaries and equipment commonly found in each case, is at full load as follows:

Per B. H. P. Hour	75 H. P.	150 H. P.	300 H. P.	700 H. P.
Pounds used....	10	6	3	2
Cost	1.625c.	.976c.	.488c.	.325c.
	.613d.	.488d.	.244d.	.163d.

From the above it is evident that the fuel cost of steam installations drops rapidly as the size of the installation is increased and proper auxiliaries added, and that gasolene (petrol) as a fuel would cease to compete with coal in installations of from about 90 to 100-horsepower output, and over, were the cost of fuel per brake-horsepower-hour the only important factor.

The deciding factor for determining the proper power limitations for gasolene (petrol) installations for each class of marine service, however, is the result of a comparison of the total costs of operation and upkeep, covering a year or more, per ton-mile traveled at any definite speed, for both the gasolene (petrol) and the steam installations. After having considered the reduction in total operating expenses made possible by the gasolene (petrol) installation, because of its somewhat lower first cost, lighter weight, smaller bulk, increased cargo space made available, greater cruising radius, smaller hull required, absence of stand-by fuel losses, reduction in crew's wages, quarters and feeding accommodations and cost, etc., it is proved in actual practice that gasolene (petrol) engines of considerably higher output than 100 horsepower are justifiable. The economical limit for gasolene (petrol) installations in the mercantile marine class of service has thus far proven in innumerable instances to be in the neighborhood of 200 horsepower; for cruising yachts not over 300 horsepower; while in high-speed naval work gasolene (petrol) installations up to 1,400 horsepower have been made and have been found justifiable. The internal-combustion marine engine industry is being forcibly convinced of the fact that beyond these limits of powering the larger sizes of gasolene (petrol) marine engines can have very scanty prospects of an active future; the high and steadily rising price of gasolene (petrol), also the limited supply in sight, rendering all the other practical advantages and operating qualifications of such engines of little or no value in competition with steam installations.

The qualities rendering the internal-combustion engine so peculiarly adaptable to marine work are too real and important to permit the restriction of such engines to the smaller installations only, the field for application of which, as above quoted, is a mere tithe of that which would immediately become profitably available to any type of engine which could burn the cheaper, heavier oil fuels, and which would involve as little carbonization, sticking of pistons and rings, fouling of igniters, self and pre-ignition, overheating, smoking exhausts, having as great flexibility of speed and power control, approximately the same fuel consumption in pounds per brake-horsepower-hour, which would not necessitate the carrying of any fresh water supply for use in the cylinders along with the fuel, and which could operate with as high a degree of success as is now attained with the internal-combustion engine that burns commercial gasolene (petrol).

Generated on 2024-08-12 20:32 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

With abundant quantities of good grades of oil fuels of 28 degrees Baumé, .886 specific gravity and lighter, available at from 2 to 3 cents (0/1 to 0/1½) per gallon, whereas gasolene (petrol), bought in large quantities, costs from 11 cents (0/5½) per gallon for the cheaper and heavier grades to 18 cents (0/9) and more for the lighter and more volatile qualities, the one great objection to the very large internal-combustion engine would be removed, provided such engines were available to operate on oil fuels.

Though America generally prides itself upon its initiative and enterprise, in many of its productive industries it is, commercially, most conservative. Capital in this country will get behind an industry and make its greater development possible only after a superabundance of proof exists that such an industry is really a most profitable investment. European capital for industrial investment is to an appreciable degree more liable to accept the chances coincident to discovering its own profitable fields for investment before such fields are very thoroughly developed; for the sake of the opportunity of securing the exclusive rights perhaps, but resulting in many instances in an unmistakable and important lead over American enterprise. This condition of mind is perhaps best exemplified in the large marine oil engine building trades, European builders having installed many hundreds of units of over 1,000 horsepower output, some being multi-cylinder installations producing as high as 2,000 horsepower in one double-acting cylinder. Even Russia, a country which many Americans appear to have believed rather behind in engine constructions of note, five or six years ago built and installed many very creditable marine oil engines in units of 800 horsepower and over, whereas America, so far, has made very little practical showing in marine oil engines of even 500 horsepower, the construction of the first American 800-horsepower unit having been attempted only this year.

Recalling that by far the greater part of the world's oil supply is produced in America, and that the present state of development of the American marine gasolene (petrol) engine is second to that in no other country in the world, it is difficult to attribute America's comparatively small showing in the larger strictly oil marine engine to any other cause than the reluctance of the American engine building investor of capital to risk his finances until it has been abundantly and thoroughly proved to his satisfaction that the problems involved in the successful marine oil engine for deep sea-going ships have been thoroughly solved—by other investors.

PROPOSED STANDARD SIZES OF CATALOGUES.—As a result of a thorough investigation by a committee of the Technical Publicity Association of New York, a movement has been inaugurated to secure uniformity in the size of catalogues. The committee recommends 6 by 9 inches and 8½ by 11 inches as the standard sizes of catalogues for all purposes. The committee also recommends 8 by 10½ inches as the size for bulletins. The recommendations of the Technical Publicity Association agree in all respects with the reports of similar committees appointed by the American Society of Mechanical Engineers and the American Institute of Architects, except that these committees recommend the 8½ by 11-inch size for both bulletins and catalogues. It is hoped that all manufacturers will adopt these standards for all future catalogues and bulletins.

THORNYCROFT 40-FOOT CABIN LAUNCH.—Messrs. John I. Thornycroft & Company, Ltd., recently completed for the Brazilian Government a cabin launch 40 feet long, 7 feet 6 inches beam and 3 feet 9 inches molded depth to be used by the Admiralty for the port of Rio de Janeiro. The engine is of the Thornycroft "N" type with six cylinders, developing 52-brake-horsepower, driving a three-bladed propeller at 1,180 revolutions per minute and giving the launch a speed of 15½ miles per hour.

On the Possibility of Building a Large Passenger Liner that Would Not Under Any of the Known Mishaps at Sea Lose Her Buoyancy or Stability and Sink*

BY GEORGE W. DICKIE

This problem has occupied the minds of many, if not all, prominent naval architects since the disaster that overtook the *Titanic* in 1912. A great deal of legislation followed this calamity, nearly all of which dealt with means of escape for everyone on board a sinking ship. In a smooth sea and with all conditions favorable it might be possible to handle and load 80 or 90 boats, and, if they could remain in the vicinity of the disaster and intelligence had reached other ships within a radius of 200 miles, a large proportion or perhaps all of these boats might be picked up. In order that this condition be possible, however, we must assume exceptional conditions.

I am writing this paper on board the *Congress*, a new vessel on her maiden voyage from Philadelphia to San Francisco. This vessel was designed by myself for the passenger and freight service on the Pacific Coast and is to run between Seattle and San Diego, the principal stops en route being San Francisco and San Pedro, the port of Los Angeles. Changes in the laws relative to life-saving apparatus added about 25 tons to the designed weight to be carried on the boat deck of the *Congress*, and, in order to maintain the designed stability, I had to increase her beam from 53 feet to 54 feet 9 inches, the boats being carried 35 feet above the load line. With a full passenger list this vessel carries 850 people, and, should it ever be necessary that they leave the ship during that part of her voyage north of San Francisco, I can hardly conceive of its being accomplished without serious loss of life. The ship itself, even with half the freeboard gone, would be so much safer and more comfortable than small boats or rafts that it is worth much thought, careful planning, some compromises and considerable money to accomplish the design of a hull which would not lose its buoyancy or stability when subjected to the known disasters of the sea and which at the same time would not be open to any serious financial or commercial objections.

The question of designing a ship that cannot be sunk by any of the known accidents which befall vessels at sea cannot be treated in a general way. The conditions are so varying in different types of vessels that the only way to handle the subject is to assume a certain type and work out the problem in its relation to the assumption, which is what I propose doing in this paper. I have taken a typical large passenger steamer of the following dimensions:

Length between perpendiculars	800 feet
Beam, molded	90 feet
Draft, loaded	33 feet

With a coefficient of .64, these dimensions would give a load displacement of 42,130 tons. There would be a complete double bottom, the inner shell being 4 feet from the outer skin, extending from the fore peak to the after peak and up the sides to the lower deck, which would be 15 feet above the base line. The main deck would be 9 feet above the lower deck and the upper deck 9 feet above the main deck amidships and would extend parallel to the base line from frame 87 to frame 233. From frame 87 to the stem this deck would slope down, touching the stem at a height of 26 feet above base, and from frame 233 it would slope downwards aft, touching the stern

* A paper read before the Society of Naval Architects and Marine Engineers, New York, December, 1913.

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

frame at a height of 27 feet. There would be 12 bulkheads extending from the inner bottom to the upper deck. These would be absolutely watertight, without doors or openings whatever, and would be spaced as follows, the frame spacing being 30 inches: No. 1, fore peak, frame 24; No. 2, frame 45; No. 3, frame 66; No. 4, frame 87; No. 5, frame 116; No. 6, frame 145; No. 7, frame 174; No. 8, frame 203; No. 9, frame 233; No. 10, frame 254; No. 11, frame 275; No. 12, the after peak bulkhead; the double bottom space being divided in the same manner. As the horsepower of such a vessel would not be less than 45,000, the boiler compartments and coal bunkers would, to a large extent, control the subdivision, and it will be noticed that I have provided four main boiler compartments, each 72 feet 6 inches in length. Each compartment is intended to take four double-ended Scotch boilers abreast, these to be 17 feet in diameter and with 8 furnaces each, giving 128 furnaces in all, or 2,800 feet of grate surface to develop 16 horsepower per foot, which would be easy with forced combustion. It will be noticed that the boiler compartments have a bulkhead at each end 16 feet from the main bulkhead. These bulkheads extend to the inner bottom and skin of the ship and are built strong enough to support the wall of coal between them and the main bulkhead. These would each have 4 coal bunker doors, one opposite each boiler. Each bunker holds 750 tons, and as there are 8 of them the coaling capacity would be 6,000 tons, all of which runs out directly in front of the boiler it is to serve. These bunkers would be filled from either side through side doors 3 feet 6 inches square with triangular side pieces forming hoppers when open, thus insuring quick coaling. The amount of coal provided is sufficient for eight days' steaming at 45,000 horsepower.

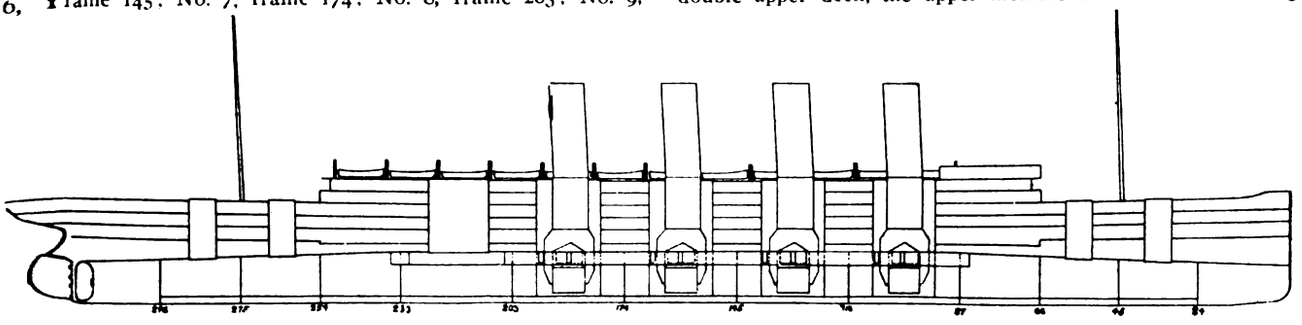


Fig. 1.—Design of Unsinkable Ship Proposed by Mr. Dickie

I think it will be admitted that this ship could be considered safe from any injury to the bottom below the lower deck and that danger of sinking would arise from rupture of the skin above the lower deck and under the waterline, which is at the upper deck line. Such danger would arise from collision with another ship at such an angle as would cause penetration or through striking some stationary mass between the lower and upper decks, opening up several compartments to the sea as in the case of the *Titanic*.

Let us first consider penetration by collision. Here the damage would be vertical and might, if the striking vessel were large and nearly at right angles, penetrate quite a distance into the side of the vessel. I think, however, that such a disaster could not entail more than three adjacent compartments if near amidships, or say 219 feet 6 inches. What would be the condition with three adjacent compartments near the center of this vessel flooded? The capacity of one of these compartments would be 163,345 cubic feet, from which would have to be deducted the displacement of the boilers, less furnaces, tubes and combustion chambers, or 13,120 cubic feet. The coal capacity would also have to be deducted, for if half the coal were used the vessel would be 3,000 tons lighter, and if the coal were all on board it would displace so much water, and for this we must deduct 52,000 cubic feet and also 1,740 cubic feet for a central watertight passage under the upper deck. This leaves 98,225 cubic feet, or 2,806 tons for each of the three compartments that we consider may be possibly injured through collision, or 8,418 tons to be carried by new displacement. In order to provide the displacement for the condition described above, I would propose to fit what I would term a double upper deck, the upper member of which would be 5 feet 6 inches above the lower amidships and parallel to the base line between frames 66 and 254, at which frames it would rise 2 feet and follow the shear line to the stem and stern. In case of a collision cutting into the upper member of the upper deck, the local damage would be confined practically to the depth of penetration and the width of the striking ship,

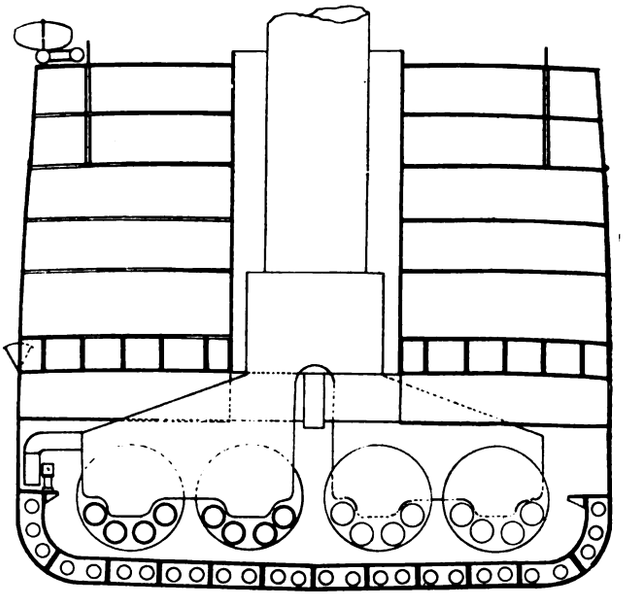


Fig. 2.—Section Through Boiler Space

as the space between these decks would be divided into very small compartments both transversely and longitudinally. As it is, we have between these upper decks 9,730 tons of displacement, which, in case of three compartments being opened to the sea, would leave the upper member still materially above the waterline. If the injury was near the forward end of the ship, the lower member of the upper deck extending downwards reduces the size of the flooded compartments and the displacement of the contents of the holds, at least 50 percent would still further have to be deducted, while the upper member rising at frame 266 and following the shear line would provide sufficient displacement to trim ship till water could be introduced into the double bottom aft. These same conditions would apply in case of serious injury aft. It will be understood, of course, that all openings through the upper deck, such as boiler and engine casings and hold hatches, would be watertight structures for at least 16 feet above the load waterline.

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

We come now to another form of disaster, the ripping open of the side of a ship for a considerable proportion of her length by striking the projecting edge of some obstruction under the waterline. In the case under consideration this might happen between the lower and the upper deck for a great portion of the vessel's length. The five large compartments would add 14,030 tons to the displacement, while the forward holds, assuming that the cargo occupied one-half the space, would add 3,800 tons more, and the after compartments, if they had to be flooded to trim ship, would add 3,400 tons, a total of 21,000 tons. This would sink the vessel 11.86 feet, or 6.36 feet above the upper member of the upper deck amidships, and she would then draw 43.86 feet. This assumption is to the very limit of the possibilities, yet, for an unsinkable ship, it should be provided against in the design. Between the upper member of the upper deck and the shelter deck there should be no air pores or side lights, or if lights are fitted they should not be arranged to open and the glass should be cast around a wire mesh as a protection against cracking.

The objection that would naturally present itself to this type of vessel is the apparent waste of space between the upper decks. This space, however, need not be wasted. Forward of frame 66 this space is 7 feet 6 inches high, increasing to 12 feet at the stem, and could be utilized to receive stores of all kinds, the compartments being only open at certain hours for issuing the day's supplies. The space from frame 254 aft, starting at 7 feet 6 inches and increasing to about 12 feet in height, could be divided into cold storage compartments for all the different kinds of provisions. The space amidships, 5 feet 6 inches high, would form the sub-basement for the hotel part of the ship above. All ventilating ducts, salt and fresh water mains and drainage pipes would be arranged in this space so that only vertical piping would be carried to the rooms. This grouping of all piping and ducts which run horizontally would save much trouble both in the design and working qualities of these systems. This I consider a very important feature in such a design. One of the hardest problems the designer has to face is dealing with pipes and ducts through living quarters and it is always the horizontal pipes that give trouble. By having the mains of these systems between the upper decks where they are accessible at all times without the passenger knowing anything about them, a continued source of dreaded trouble is removed, and furthermore this would not interfere with the proper subdivision of the space.

Referring to the cross-section through one of the boiler compartments, it will be observed that I have provided a longitudinal passage under the upper deck. This passage would be extended through each compartment, from which it would be entered through an air lock and it would extend from frame 87 to frame 233. In each boiler compartment on each side would be the living quarters for all the men engaged in that compartment. These quarters would be artificially lighted and ventilated. The air would be taken from ducts between the upper decks on the inboard side, discharge at the floor line, and would pass up through ventilating pipes on the outboard side. It might be objected that these quarters would be hot in spite of good ventilation. In this connection I consider it quite unnecessary to have much heat in the boiler rooms. The boilers in such a ship would be worked under forced combustion and in that case the fans for forced draft could draw the air from the outer casing round the smoke stack and upstakes and discharge it into a casing outside the boiler lagging so arranged that the air would circulate round the boilers on its way to the tubular heaters in the upstakes. Thus any heat radiating through the lagging on the boilers would be taken up by the air for combustion, leaving the firerooms comfortably cool, and with cold air freely circulated through the living quarters they should be quite comfortable.

The air lock doors into the central passage would be self-closing, balanced doors, easy enough for a man to open, but certain to close after him, and it would hardly be possible to conceive of any damage to this passage even from a collision with a very large ship. At both ends of this passageway would be stairs in a watertight well leading to the shelter deck.

The compartment forward of the forward boiler compartment would contain the main ventilating fans with cooling and heating chambers for the air. These ventilating fans would be supplied from trunks extending well above the weather deck and their capacity would be such as to insure thorough ventilation throughout the ship. The compartment aft of the main engine-room would be the electric generating room, where a sufficient generating plant would be installed to insure perfect lighting, heating and ventilation.

I have not, of course, tried to work out all the details for such a ship. What I have done is intended to be suggestive. A vessel built to carry out correctly such a suggestion would, I am sure, be practically an unsinkable ship and, with all her fire mains controlled from the interior of the upper deck, it would hardly be possible for a fire to gain great headway. We have just heard by wireless that a fire had broken out on the *Imperator* in New York harbor. This would indicate another form of possible disaster to the great modern passenger liner. The double upper deck would offer many advantages in case of fire. The fire mains, probably six in number, would all be installed between these decks and vertical pipes from these mains would extend up to every room, in size and number proportionate to the size of the room. By means of these numerous rising pipes, any room in the ship could be immediately drenched with water and these pipes could be arranged to be operated either from the room where the fire occurred or from between the upper decks. By this means water would be applied only where there was fire and no damage would result outside of the place where the fire started. As a fire could not possibly occur between the upper decks and as this space is well ventilated, no part of the ship would be beyond direct control of the fire mains and much of the unsightly attachments for fire hose in the living quarters could be done away with.

With a vessel so constructed would it be necessary to carry the great load of boats and gear for handling them that, under present conditions, is considered so necessary?

Obituary

Herman Charles Meinholtz, vice-president of the Heine Safety Boiler Company, died at St. Louis, Mo., Dec. 24, at the age of 45. Mr. Meinholtz entered the employ of the Heine Safety Boiler Company at the age of nineteen as a draftsman, and was continuously connected with that company up to the time of his death. He was made superintendent in 1895 and vice-president in 1907. He had entire charge of the company's shop when it was established in 1899, and under his general direction the company's new factory was designed and built in 1909, and since that time it has been under his direct supervision. Mr. Meinholtz was a member of the Engineers' Club of St. Louis and of the American Society of Mechanical Engineers.

Jordan M. Fritzius, aged 78, prominent for sixty years in the industrial life of the lower Monongahela River Valley, died in Pittsburg Jan. 14. He began the boat building business when 16 years old, and remained actively in this business through all its devlopments until he retired a year ago. In the early days the timber with which he constructed boats was cut at points up the Allegheny and Monongahela Rivers and floated down in great rafts. When he retired Mr. Fritzius was building steel barges and steel hulls for steamers used in the rivers of South America. For many years he was closely associated with the late Col. W. R. Jones at the Edgar Thomson Steel Works in Duquesne.

Generated on 2024-08-12 20:33 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

McAndrew's Floating School

BY CAPTAIN C. A. McALLISTER*

CHAPTER XIX

Care and Management of Engines and Auxiliaries

The *Tuscarora* arrived in New York and was loaded for her first trip South after the extensive repairs she had undergone. The chief had, of course, been so busy attending to getting the vessel's stores, etc., ready for her regular trips that he had paid no attention to his class other than to caution them to keep on with their studies and to learn as much as they could from observation, keeping in mind what he had told them about the various parts of the machinery.

There was a new second assistant by the name of Davis on board, and he had been placed in charge of the boilers. Coming into the fire-room suddenly one day he found O'Rourke delivering a lecture to a couple of coal passers on how steam was generated. "This blatant heat," he was saying, "is what makes you fellows hustle out the coal; it's like shoveling snow in the East River to make the tide rise; you don't seem to get a run for your money until all of a sudden—'biffo,' the steam shows on the gage!"

Davis could stand it no longer, and said, "Cut that out, O'Rourke, and get down to work—what do you know about steam, anyhow?" This highly incensed the shining light of the Floating School, and he replied rather impudently that he "was only trying to give these ginks a little scientfic dope." Later in the day O'Rourke complained to the chief that the second assistant had cut short his efforts at enlightening the coal passers on matters he had learned at the school, but he was told to pay more attention to his work and not to bother with imparting his knowledge to an unappreciative audience.

The ship sailed from New York at her scheduled time, and was soon bucking into a southeaster as she headed down the coast. It cleared off the next day, and as everything was working smoothly the chief rounded up his class that afternoon, all of them being off watch, and proceeded to give them some further instruction.

He began his remarks by saying that it was a most unusual thing for a chief engineer of a vessel to take time while his vessel was underway to be holding a school for his men, but as he had only a little further to go in his remarks he was determined to finish the job up, even if he did have to defy all precedents.

"Having told you something about the care and management of boilers, I propose this afternoon to give you some hints on the care and management of the main engine and the various auxiliaries in the engine room.

"An engineer standing a watch at sea has so many things to attend to that to enumerate them all would fill a book in itself. Probably no other business requires so much alertness and quick acting and thinking as a marine engineer is called upon to do in the proper performance of his duties. Every faculty which God has given him is called into use. Unlike locomotive and stationary engineers, he must never allow his engines to stop for days and days at a stretch. A locomotive will be driven for five or six hours and then run into a roundhouse for a rest; a stationary engine will be run for ten or twelve hours and then stopped; but it is very seldom that a marine engine is ever stopped or even slowed down in a voyage lasting very often a week, or even two weeks at a time. To do this successfully requires the highest degree of skill, and above all things the closest attention to even the most minute details, as the derangement of even a very small part of an engine often results in a serious breakdown at a critical moment. Remember, young men, that to be successful in your business as an engineer there is no detail about the entire mechanism of a ship that is too trivial to demand your closest attention.

"Preparations for getting underway for a long trip at sea should begin early in the morning of sailing day. If repairs or adjustments have been made during the stay in port, the engineer should personally see that every set-screw on the moving parts is set up tight; that all the bearings have been oiled around by hand; that all oil cups are filled; that the sight-feeds are properly adjusted and in working condition. To make sure that all parts of the main engine are clear, it is well to turn the engine at least once clear around, either by hand or with the jacking engine. After this is done he should personally see that the worm of the turning gear is thrown out of gear; failure to do this has cost many a man his job.

"The first thing to do is to start the circulating pump slowly and get the condenser cooled off and ready for the exhaust steam. An hour or more before time to start, depending upon the size of the engine, steam should be admitted slowly to the steam jackets around the cylinders, if there are any, if not steam can be let into the cylinders direct by cracking the throttle slightly and opening the by-pass valves. All drain valves from cylinders and valve chests must be kept open to the condenser, as steam striking the cold cylinder walls is immediately turned into water, and should be allowed to drain into the condenser.

"The warming up of large iron castings must be done slowly and thoroughly—never make haste in this process unless in a great emergency. After the cylinders are too hot to bear your hand on them, and having ascertained from the people on deck that sufficient mooring lines are out, steam may be admitted to the engine very slowly at first, and the turns gradually increased to not more than half-speed. The reversing engine should be tried back and forth a number of times to see that it works satisfactorily, and to see that the main engine will run well in the backing gear. The water service should be started. The drain valves should be kept partly open all the time that the engine is being warmed up, and, in fact, they should not be closed altogether until the vessel is underway from the dock for at least ten or fifteen minutes.

"Before sailing the chief engineer has, of course, satisfied himself that all necessary stores are on board; that the oil tanks are filled up, and that all wrenches and other tools for making quick repairs or adjustments are in place and easy of access.

"Everything now being ready, and the captain advised of that fact, the engineer stands by the throttle, posts a man at the engine-room telegraph, which has been previously tried and found to work satisfactorily, and awaits the starting signal. All signals from deck must be answered promptly, as in working away from the dock and through the crowded harbor any delay whatsoever in quickly working the engine as directed would be dangerous. Full speed is seldom ordered until the vessel is well clear of the harbor, but when it is rung up the throttle should be opened only to such an extent that the engine will just use up all the steam that the boilers will make, and will maintain a uniform number of revolutions. Fluctuations of the steam pressure should be avoided as much as possible, and so far as he is able the engineer on duty should strive to carry uniform boiler pressure, revolutions and vacuum.

* Engineer-in-chief, U. S. Revenue Cutter Service.

Generated on 2024-08-12 20:26 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

"The first few hours of a run the man on watch should be unusually alert in feeling bearings, especially those which may have been recently adjusted, in order to detect the first sign of unusual heat. When a bearing starts to warm up it gets 'red hot,' as the saying is, in very short order, and should be given instant attention. The causes of hot bearings are in most cases due to being set up too tight or else from insufficient oil supply. Occasionally heating is due to the presence of grit, but that can only result from rank carelessness in not having the bearings sufficiently covered up or otherwise protected when the engine is not in use."

"How do you cool a hot journal without stopping the engine?" inquired Nelson.

"Put cold water on her, of course, the same as you would cure a headache," volunteered O'Rourke.

"That's the very last thing you should do," continued the chief. "The first thing is to give it a large dose of oil, and in nine cases out of ten you will find that it will gradually cool off from that treatment. If it persists in heating up after you are sure that it is getting plenty of oil get out the proper wrenches and slack off the nuts a trifle. This generally accomplishes the object sought, but if even that method fails then resort to the water service, as sparingly as possible, but just enough to keep down the heat. If the ship was running in fresh water the effect would not be so bad, but salt water on a bright journal is harmful."

"I get you, chief," broke in the effervescing O'Rourke. "Curing a hot bearing is just like curing a man of a stomach ache. If it isn't very bad give him a dose of castor oil; if it gets worse put on a mustard plaster; if that don't work give him an injection of fresh water, not salt, as that would hurt him."

"Your powers of comparison are certainly well developed, O'Rourke, but I fail to see the similarity between slackening up a bearing and putting on a mustard plaster."

"Well, if that mustard plaster attends to its business all right the man will want to slack it up, you can bet."

"Chief, will you please give us some points on oiling," suggested Pierce, who was feeling the responsibility of his new job.

"I was just coming to that important subject," replied the instructor. "Oiling, like water tending, is a very important job on board ship. Although people refer in a slurring manner to the 'greasers' there are few jobs anywhere which have the importance of a marine oiler. A little inattention to his duties may result in doing great damage to the machinery, and may even stop or cripple the ship. An oiler in his rounds must be as regular as clock work, and constantly on the alert with his senses of feeling, hearing, seeing and even smelling. To a trained oiler all these senses come into play. By feeling of revolving crankpins, eccentric straps, main journals, etc., with his hands he can tell instantly if any of them are overheated, or even if they show a tendency to heat. To his sensitive ear the first discordant noise, even the slightest squeak, will indicate that some bearing or journal is running dry and needs immediate attention. His eyes must be sufficiently keen of vision to see minute and almost invisible drops of oil passing down the tubes of automatic oilers, and at times to discern even the slightest sign of smoke, which would indicate an overheated bearing. His sense of smell is called into play to detect the first indication of overheated oil or grease."

"What about his sense of humor," inquired Schmidt.

"Every oiler must have that sense well developed also, as his main object is to prevent any squeaks or groans from the bearings under his charge.

"In giving advice to you on oiling I want first to warn you against putting too much dependence on automatic oiling gear of any kind. Such apparatus is all right when it works well, and I must say that it does work well for 99 percent of the time; but there is always that small percentage of the time when it does not work well that you must guard against. A change in the temperature of the air surrounding a needle valve on oil reservoirs will often change the adjustment of the drip, so that the bearing to which it directs the flow of oil will not receive a sufficient quantity and become heated. The same trouble might be started by a small speck of dirt or grit getting under the valve. Therefore these contrivances must be given very close attention.

"Many engineers prefer the old-fashioned wick feeds, as they are much more positive in their action, although not quite so easily adjusted.

"Most oilers, and especially beginners, use entirely too much oil, both from oiling by hand and from the automatic feeds. However, this tendency is quite easily regulated by the system of putting every man on an allowance for his watch. The good oiler usually finds his allowance to be ample, whereas the negligent man and the inexperienced man have to hustle to keep things running cool on the amount given them.

"A routine should be established, the time between oilings being regulated to suit the speed of the engine and the necessity for the oil. Usually crankpins and eccentric straps should be oiled by hand once each twenty minutes; the main journals, link gear, etc., once each half hour. An inspection of the thrust bearing, spring bearings and stern tube gland once each half hour is usually sufficient. Piston rods and valve stems should be swabbed every half hour, but as little oil as possible should be used each time, as it is by this means that oil gets inside the cylinders, is carried into the condenser and then pumped into the boilers. This is an evil that must be guarded against as much as possible.

"On many modern ships no oil whatever is used to lubricate the main engine pistons and valves; if any lubricant is necessary many engineers use graphite mixed with water. As a matter of fact in engines using piston valves, internal lubrication is not absolutely necessary. The cylinder walls are always at a less temperature than the entering steam; consequently some of the steam is condensed, and the water formed by this condensation acts as a lubricant.

"On the smaller engines, used as auxiliaries, such as pumps, blowers and dynamos, internal lubrication seems to be more of a necessity, and it is by this means that oil gets into the feed water and later into the boilers. The introduction of the steam turbine for driving dynamos and pumps does away with this danger, as, of course, no oil is necessary for the interior of turbines.

"Many engineers prefer to use grease, or compound, as it is termed, on small journals, and on those which have but little friction. Cups, known as compression cups, are screwed to the caps of such journals, and the oiler, by simply giving a small twist to the screw top on the cup, forces enough grease on the journal to last sometimes for several hours. Some engineers use grease for thrust bearings and tunnel bearings, but it is more economical to use oil. On well-designed thrusts the collars on the shafts are made to run in a bath of oil, which is kept cool by salt water circulated through coils in the bottom of the bearing.

"Oil should be caught in the drip-pans and passed through oil filters, of which there are several good types on the market, after which it can be used over again.

"It takes experience to make a good oiler, but, of course, you cannot get the experience without actually doing the oiling. In your first attempts you will do well if you only take the bark off your knuckles, and perhaps lose a finger nail, while feeling the crankpins and eccentric straps. This is a very important part of his duties and can be learned only by practice. One good rule to remember is never to feel a rapidly-revolving piece of machinery that is running toward you; wait until it starts to go away from you and then feel it very quickly. No day-dreamer can be successful, as feeling of crankpins, etc., requires quick action. Wherever it is prac-

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

ticable on fixed bearings use the backs of your fingers to feel with, as they are more sensitive to heat than the hardened working surfaces of a man's hand."

"Schmidt ought to use that nose of his, as they say he is very sensitive about the length of it," suggested O'Rourke, who, for him, had been silent for a long time.

Schmidt retaliated by saying that it would never do for O'Rourke to use his cheek for feeling journals, as the metal would have to be red hot for him to even notice it by that method.

McAndrew called them both down hard for making such personal references, and said that oilers were supposed to be courteous to one another. If they are not there might be all kinds of trouble when relieving one another as the watches changed. "The man about to be relieved," said he, "must have all his oil reservoirs filled up and all the bearings and journals under his care running cool, or otherwise the oiler coming on watch could refuse to relieve him.

"I hope," he continued, "that O'Rourke and Schmidt never have to relieve one another from oilers' watches, as I am afraid they would both be standing double watches the greater part of the time."

"Chief, won't you put us onto some of the duties an engineer has to do in port?" suggested Schmidt, who was probably the most eager for knowledge of any in the class.

"Certainly," replied the general instructor. "The first thing most of them do is to beat it for their own homes, or someone else's home, according to circumstances. Of course, that is natural, as a man who stands engine-room watches for a week or more at a stretch, is mighty glad to hit the beach and stretch himself out in a four-poster at least one night in ten; but, seriously speaking, there are many important things which the engineer's gang must do before sailing day arrives again. Nowadays any repairs involving machine work of any description is put into the shops, as the engineer's force usually has neither time nor the necessary tools for making any very extensive repairs. The work most usually performed in port might be divided up under four headings. Cleaning is one of the first things to perform; adjustment of bearings must be attended to; making new joints and packing of stuffing-boxes must be performed, and examinations of the interiors of cylinders and the auxiliaries must be made periodically. These four divisions of work probably constitute nine-tenths of the duties performed in port.

"As soon as the jingle-bell is rung, signifying 'through with the engine,' the boys should be set to wiping the engine down and cleaning up the floor plates. Some engineers like to have a small injector so fitted and connected up that it can be used to wash down the bed-plates and bilges with hot water; but I don't believe in squirting salt water indiscriminately about an engine room, as it is bad for the bearings and bright work. Gaskets, made of hemp, loosely laid up, should be laid across both ends of all the principal journals to keep out any dirt or grit which might be around while the engine is not in use. During the stay in port, bulkheads should be scrubbed if they have become dirty, storerooms cleaned out and put in good order, bilge strainers cleaned thoroughly, the bilges themselves cleaned and kept well painted, the filtering material renewed in the feed tank, and in a general way the whole department given such cleaning, painting and renovating as cannot well be done while the machinery is running.

"The adjustment of bearings is probably one of the most important duties for the engineer and his assistant. If a bearing runs a little slack and develops a slight pound it should be carefully readjusted, or if there has been a tendency for any particular bearing to heat up during the trip it should be examined, and if necessary overhauled and readjusted while the ship is at the dock."

"Why are they always monkeying with the crankpins on this ship?" asked O'Rourke. "It seems to me," he continued, "that that is all one of the assistants does while this ship is at the dock. I see him running around with something that looks like a handful of spaghetti, and he is always saying that he has got her down to 29, or some number like that. You'd think he was running a keno game. He ought to——"

"Well, O'Rourke," interrupted the chief, "if you're running this talkfest I'll quit and let you take the chair."

"I'm through," meekly replied the Hibernian, realizing, for once at least, that he was sat upon.

"Bearings lined with white metal are now almost universally used," said McAndrew, after re-establishing himself as boss of the school room. "These wear down considerably during long-continued runs, and consequently must be adjusted more often than the old-fashioned bearings of solid brass. In the early days it was the test of a good engineer to make adjustments by chipping and filing down the edges of the brasses uniformly, as that was the method then in vogue. All bearings in these times have pieces of brass, known as distance pieces, between the upper and lower brasses; when the wear has been excessive these distance pieces can be planed down in a shaper very quickly. However, that is seldom necessary, as liners, or shims, consisting of varying thicknesses of sheet brass, are also fitted between the distance pieces and the brasses. By removing one of the thinnest liners a very small lost motion can be taken up and the tendency of the bearing to pound prevented. Of course, it is necessary to have some slight clearance to all bearings, else it would be difficult to distribute the oil over the rubbing surfaces. A good rule to remember for the amount of the clearance is that for every inch of diameter of a bearing there should be two one-thousandths of an inch of space. Thus for a 12-inch crankpin the clearance should be $12 \times .002 = .024$ inch. This corresponds practically to No. 24 B. W. G., which is a safe clearance space. Some engineers would set them up tighter than that, but when they do there is always a good chance for them to heat. By the same rule a 6-inch diameter crosshead pin should have .012 inch clearance, which corresponds to No. 30 B. W. G."

"What's that mean, chief?" asked Pierce.

"B. W. G. means 'Birmingham Wire Gage.' Wire, you know, is made of a great many different diameters, and instead of expressing them as so many thousandths of an inch, it is much simpler to say No. 1, 7 or 27, or whatever it happens to be. Birmingham in England is one of the leading wire manufacturing communities, so the gage most generally used is the one which was adopted at that place many years ago.

"In adjusting a bearing, as, for example, the main bearings of the engine, the cap or top part should be removed by means of a chain hoist, and the white metal and oil grooves examined. If it is found that the brass does not bear well on the shaft journal it must be scraped down to a good fit. To do this properly the journal should be smeared over with a thin coating of red lead and oil and the cap put back in place. Where the white metal of the brass touches the shaft there will be red spots. These spots should all be carefully scraped down and the cap again tried as before. After this is repeated several times, the brass should be found to bear on the journal quite uniformly. Always remember that the principal bearing should be in the center of the brass. The outside edges should not touch at all, for if they bear on the journal when it is cold it will be found when the temperature of the bearing rises to a working heat there will be a tendency for the edges to squeeze in on the shaft; or nip, as it is termed, which will cause the bearing to become overheated. It is also necessary to fit them in this way to provide for wear, the heaviest of which is naturally in the center of the brass. After the bearing is found to be satisfactory, so far as its surface is concerned, the oil grooves should be carefully cleaned out, and enlarged where necessary, as it is of vital importance to have

Generated on 2024-08-12 20:26 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

the grooves amply large and so placed that a uniform distribution of the oil will take place.

"For final adjustments three strips of lead wire about 1/16 inch in diameter should be laid across each journal, one at each end and one in the middle. The cap should then be replaced, and the main bearing nuts set down as tightly as possible by means of a box-wrench and a sledge. The position of the nut in reference to the end of the bolt should be marked with a scriber, so that you will know how tight to set up on the nuts after the cap has again been taken off and the three pieces of lead wire removed. The leads, as they are called, should be measured by means of the wire gage, to see that they are of about the thickness necessary for the desired amount of clearance. A more accurate method for determining the amount of clearance from the leads is by means of the micrometer."

"Mike who?" interrupted O'Rourke.

"Don't let that word bother you, as the instrument is not an Irish invention, even if its first name is Mike," rejoined McAndrew. "It is more than likely it was invented by a German; but at any rate it is a very useful measuring machine, by means of which, through the medium of an accurately cut screw head and a graduated sleeve, thicknesses of one-thousandth of an inch, and even of one ten-thousandth inch can be readily measured. When you get to be engineers you will find it very useful to save these leads, or spaghetti, as O'Rourke calls them, for future reference. A convenient way to do it is to get a large brown-paper book, a scrapbook will do, and cut slits in the pages through which the leads can be held in place. Mark under each set of three leads the name of the bearing from which they were taken, the date, and opposite several points in their length jot down the thicknesses in thousandths of an inch.

"Even if a crankpin has been adjusted to your satisfaction by means of leads, it is always a wise precaution to put the end of a pinch bar in between the end of the brass and the crank-web, and if it does not move with a 'chug' after a quick yank on the other end of the bar, the brasses are probably too tight, and should be slacked up slightly until they can be moved in that manner.

"When eccentric straps become noisy, they should be taken apart and a small shim removed; but they should never be set up so tight that they cannot be moved all around by hand after the bearing surfaces have been oiled.

"Journals connected with the valve gear do not need adjusting very often, but when they do it is a comparatively simple matter, especially if they are fitted with strap, gib and key connections, as many of them are. When first constructed it is usual to leave from 1/16 inch to ⅛ inch clearance between the two brasses, so to adjust them afterwards it is only necessary to drive the taper key in a little further, always being sure to set up tightly on the set screw.

"Many small pin bearings where the wear is trifling are fitted with solid bushings of brass. When they become badly worn the bushings should be renewed.

"The making of new joints and packing small stuffing-boxes should be attended to while the vessel is in port, as there is nothing that annoys an engineer more while the vessel is underway than to have one of these blow out. It is a strange fatality, if I might call it that, that joints and stuffing-boxes always give way at the most inopportune times. A joint will run along perfectly tight while the ship is in a cold climate, but just as soon as she gets down South, and on some particularly hot day, 'bang!' out blows the gasket, and fills an already hot engine room full of steam and vapor.

"Then, too, it is generally the joint which is hardest to get at which lets go, while some joint that is easily remade will run along as tight as a bottle for months at a time. The engineer who is onto his job will have all suspicious joints remade while the vessel is tied up to the wharf and there is time to do the job properly.

"The making of joints and packing of stuffing-boxes is something you will have to learn from actual experience. The various materials from which gaskets are made are as numerous as the first man up San Juan Hill, and some of them just about as reliable. As a rule, you should use only rubber gaskets for joints in water pipes. For steam joints various fibrous materials, asbestos woven with wire and usudurian are the best and last longest. In making steam joints you must be exceedingly careful to see that all the old material is scraped from both flanges, and that the flanges themselves are parallel. The holes in the gasket should be cleanly cut, and before it is slipped in place the packing should be smeared over on both sides with black lead and tallow or cylinder oil. Set up on the bolts just as tightly as possible, but not so hard as to twist some of them off, as is done occasionally by muscular young men like O'Rourke."

"Honest Injun, chief, that wasn't me that twisted that stud off the feed pump this morning. I won't say just who it was, but I think he can speak German," protested O'Rourke.

"Oho! so one of you is guilty of that very same thing only this morning, eh? Well, whichever one of you highbrows it was will have the pleasure of putting in a new stud while you are resting yourselves off watch to-morrow.

"As I was saying," resumed McAndrew, "the bolts on a new joint should be set up as tightly as possible, and then after steam has been on the pipe for an hour or so, they should be followed up, as the saying is, as the heating of the gasket usually allows a little more tightening.

"In packing stuffing-boxes, the turns of packing should be put in so that the joints do not come opposite one another, and this packing should also be rubbed down with black lead and tallow."

"Why do you do that, chief?" asked Nelson.

"It isn't that it does any particular good in keeping the stuffing-box tight, but it makes it much easier to remove the packing when it is worn out and again has to be repacked. In marine engineering, no matter what you do in the way of construction or repairs, you must provide for all manner of things which may happen in the future. You don't want to be caught like the man who built a boat having a 6-foot beam in a cellar with only a 3-foot door to get it out of and didn't notice the difference until the boat was finished.

"Certain parts of marine machinery need to be inspected to see that everything is in good condition. I don't believe, as some engineers apparently do, in taking an engine or an auxiliary apart to see what makes it work so well, but at regular periods, say every three or four months, the cylinder heads should be lifted to see that none of the follower bolts is cracked or has become loose. Water ends of air pumps, feed pumps and bilge pumps should be examined quite frequently to see that the valves have not become too much worn and the springs are not broken and are in their proper places. This is particularly necessary if rubber valves are used. The main condenser should be watched closely to see that no leaks have developed in the tubes. This is generally indicated by the water getting too high in the gage glasses on the boilers, as salt water will leak through the tubes to the fresh water side of the condenser and mix in with the feed water, causing a surplus. If you have reason to suspect that any of the tubes are leaking the condenser should be filled with water, the water chest at each end removed, and the ends of all the tubes examined carefully to see if any water is running out. If it does, that indicates that the tube is leaking and it should be removed at once. If there are spare tubes on hand fit one of them in its place or else plug up the holes in the tube sheets.

"After several months of use, condenser tubes become covered with grease from the exhaust steam and fall off in their efficiency of transmitting the heat from the exhaust steam to the circulating water. This is generally indicated by the vacuum falling below its usual height, and the con-

Generated on 2024-08-12 20:26 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

denser should be boiled out with a strong solution of soda and water heated by means of a jet of steam.

"There are, of course, many other jobs to be attended to while a vessel is in port; in fact, the duties of an engineer while the vessel is tied up remind me of the tribulations of a 12-year-old playmate of mine when I was a youngster. He would get home from school about 4 o'clock in the afternoon, and upon reporting to his fond stepmother would every day be saluted about as follows: 'Now, Lewis, you hurry up and get ten or twelve baskets of chips from the shipyard; run up to the grocery store for me; hoe five rows of potatoes; chop the kindling for the morning; get six pails of water and then you can play the rest of the time before supper.'

"After performing all the numerous chores I have told you about which have to be done in port the average engineer who follows the sea can play the rest of the time; but I am afraid that it is mostly after supper that he finds the opportunity."

(To be continued.)

Diesel-Engined Tugs

BY J. RENDELL WILSON

During the last few years so much attention has been drawn to the advantages of the Diesel type engines for ocean-going ships that little has been done to direct the thoughts of shipowners toward the adoption of this class of power for towboats, so it is doubtful if there are more than a couple of dozen Diesel-driven tugs in service in all parts, and probably the majority of these are working in Hamburg harbor.

For many reasons this class of engine shows vast economy over gasoline (petrol) and steam machinery for this particular type of boat, chiefly because of the low grade of oil fuel that can be used, and the near future should see the substitution of heavy oil engines for the gasoline (petrol) and steam engines in the thousands of tugs in service in various parts of the States. Before this can occur however, the manufacture of these motors will have to become more general in America, and better arrangements for distribution of heavy oil fuel will have to be made by the oil companies. As soon as the demand comes, however, this should offer no difficulty, as the refiners will be enabled to distribute the oil through the medium of the present gasoline (petrol) stations. In England and on the Continent heavy oil fuel, although very expensive, is now obtainable practically anywhere, and this state of affairs should soon prevail in America.

As to the construction of the machinery, the New London Ship & Engine Company, of Groton, Conn., has already made considerable headway, and other concerns will soon be in full swing, including the American branch of Krupps, the famous German naval firm. The economies, however, are so considerable that it pays a shipowner to order an oil engine from England or the continent, despite the extra carriage and duty.

In addition to fuel consumption, the advantages over steam are: No standby charges, no stoker, less bunker and machinery space and the opportunity of carrying a moderate cargo if desired. A good example will be found in Fig. 1, which shows a tug and icebreaker designed by the A. B. Diesels Motorer, of Stockholm. The tug is 56 feet in length, 53½ feet between perpendiculars, with 14 foot molded beam, 9½ foot molded depth and a draft of 6 feet. Her engine is a four-cylinder (with two extra maneuvering cylinders) Polar-Diesel of 120 brake horsepower, which drives the boat at 9½ knots. The engine-room is placed amidships, between bulkheads, and on either side of the engine are arranged the fuel and compressed air tanks, and the total space required is just 14 feet by 14 feet, and the weight of the machinery is 9 tons. A steam engine of the same power, i. e., about 160 indicated horsepower, with boilers and condensers, would require an engine-room about 45 percent larger and the machinery would weigh 90 percent more. With a fuel supply of 6 tons the Diesel tug could run for 230 hours, as against the 45 hours of the steam tug with the quantity of coal, which, by the way, would require more space. As the average costs per ton of the two fuels, I believe, are about the same in the States, the economy is at once apparent, as in one case we have a cruise of 2,185 nautical miles with 6 tons of fuel, and in the other but 427½ nautical miles with the same amount of fuel. This boat has excellent accommodations, which consist of a wheel house, galley and lavatory on deck and captain's cabin, cabin peak, messroom, pantry, engineer's cabin, crew's cabin, storeroom and water ballast tank below deck.

Let us now turn to the question of gasoline (petrol) versus heavy oil. The latter type of engine is heavier and generally runs at slower revolutions, but owing to the greater power-giving efficiency and propeller efficiency the actual space required for the two installations will be about the same; but the Diesel will cost about 15 to 20 percent higher, and if imported from abroad another 45 percent will have to be added to the first cost.

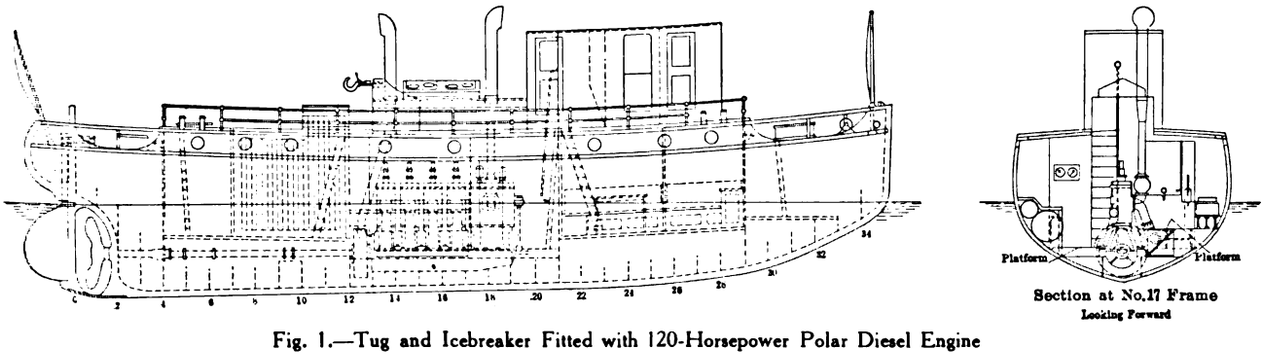


Fig. 1.—Tug and Icebreaker Fitted with 120-Horsepower Polar Diesel Engine

For the purpose of comparison we will take a gasoline (petrol) motor of 150 brake horsepower and a Diesel of similar power, the former having a fuel consumption of .75 pint per brake horsepower hour, and the latter .5 pint per brake horsepower hour. In actual practice the consumption would be more likely to be .80 and .45 pint, respectively, so we are quoting in favor of the gasoline (petrol) motor. The cost of the fuels per gallon will be about 20 cents (0/10), and 5 cents (0/2½), respectively, so the gasoline (petrol) motor has a consumption of 132½ pints, or say, roughly, 16 gallons per hour, while the Diesel engine consumes 67.5 pints, or about 8½ gallons per hour.

Thus for a voyage of 12 hours at full speed the gasoline (petrol) tug will require 192 gallons at 20 cents (0/10), or a fuel bill of $38.40 (8/0/0), as against 102 gallons at 5 cents (0/2½), or a fuel bill of $5.10 (1/1/3). Working for 330 days of the year this means that the cost of fuel for the gaso-

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

line (petrol) tug is $12,672 (£2,600), while the Diesel towboat total fuel cost is $1,775 (£364). This shows a saving of $10,897 (£2,236) per annum, out of which we should allow the odd $897 (£183) for the renewal of exhaust valves, etc, which is fairly frequent with some types of Diesel engines. However, it is obvious that $10,000 (£2,062) saved yearly is well worth the extra first cost of this class of engine, and in some cases of even the actual scrapping of existing machinery. The original cost of a 200 brake horsepower Polar-Diesel marine motor of the best finish is about $12,200 (£2,500), with accessory fittings, such as compressors, tanks, etc., or some $1,220 (£250) less for the bare engine.

Several of the existing Diesel tugs are of much higher horsepower than this, while Messrs. Benz & Company, of Mannheim, Germany, are now building one of 500 brake horsepower, and there is no reason why 1,000 horsepower motor tugs should not be built if required, as there are no engineering difficulties now in the way. The Nobel Bros. Naphtha Company, of St. Petersburg, have had a large twin-screw motor tug, the *Jakut,* running for several years, and Fig. 2 illustrates this boat. She is driven by two 160 brake horsepower Polar-Diesel engines, which turn at 240 revolutions per minute, and was placed in service in 1910. Some time ago she and a sister steam towboat put out from Astrakan to render assistance to a steamship that was fast in the ice. From the time of leaving harbor to the time of the return the consumption of oil was 267 pud, compared with the consumption of coal, which was 1,974 pud.

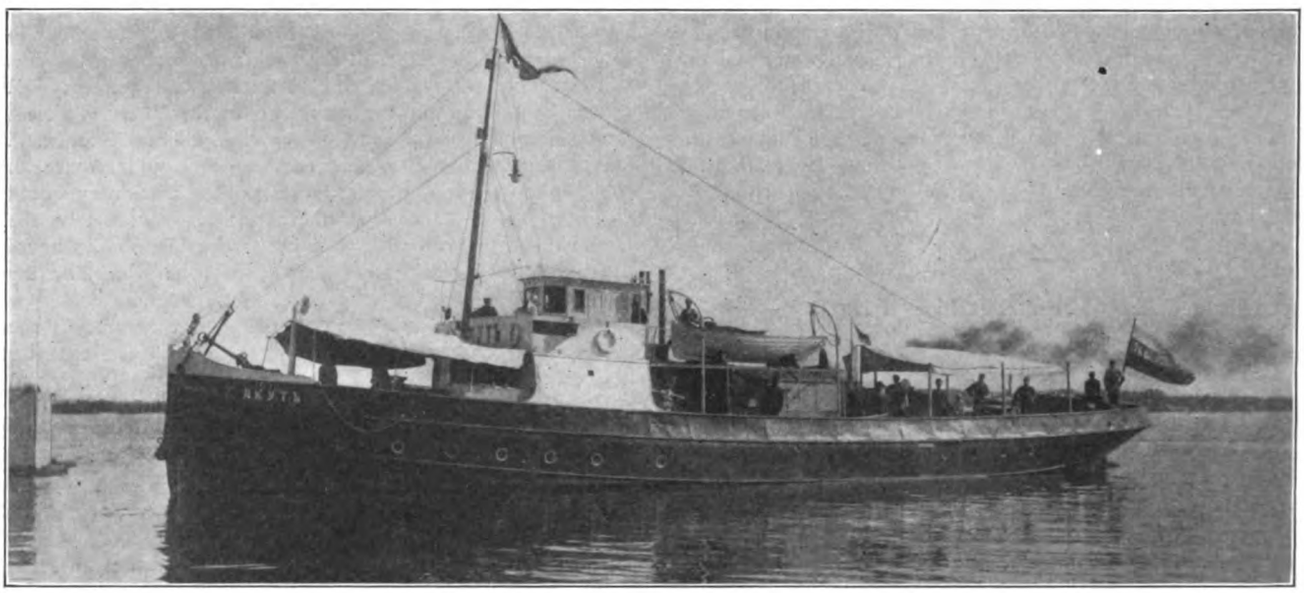


Fig. 2.—Diesel-Driven Twin-Screw Tug *Jakut*

In a recent issue of a London motor boat paper is given details of the wonderful economies effected by an oil-engined combined tug and cargo boat owned by Crosse & Blackwell, and now working on the Thames. Before the advent of this craft the owners paid about $200 (£41) per week for towing by steam towboats, whereas the running costs and upkeep, which includes wages, insurance, overhaul, depreciation and interest on the first cost of their new motor boat, only amounts

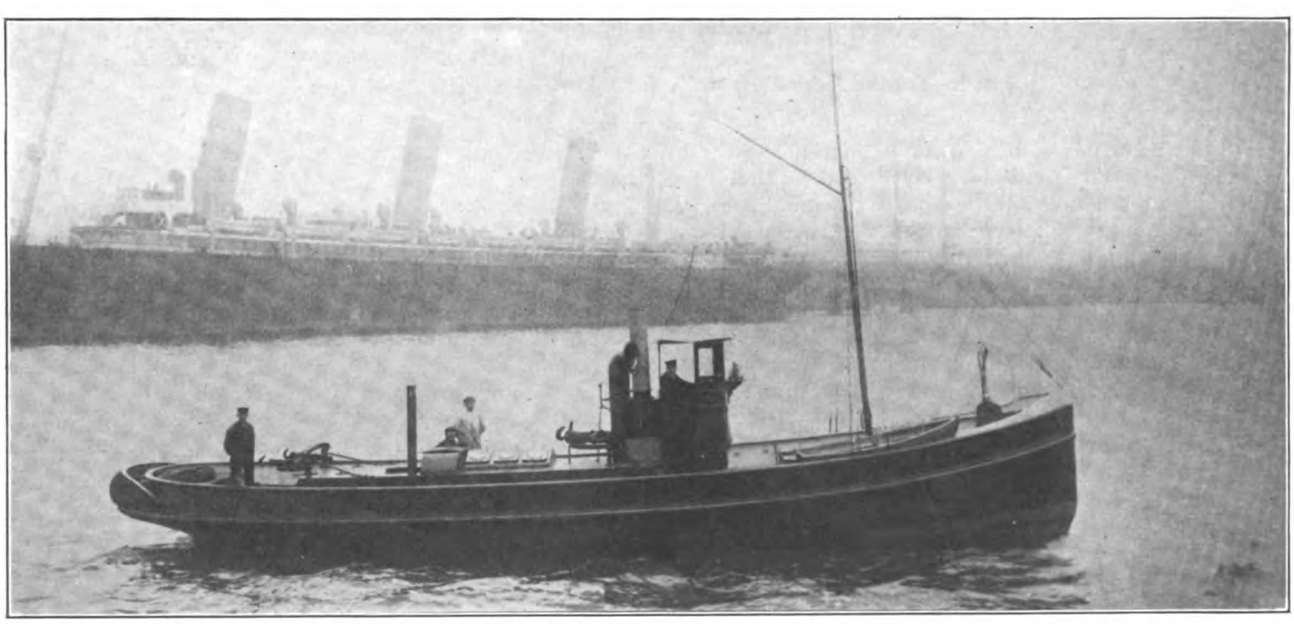


Fig. 3.—Sulzer-Diesel Engined Tug in Hamburg Harbor

Generated on 2024-08-12 20:32 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

to $62 (12/18/4) per week, so that there is a direct saving of $138 (£28) per week, apart from the additional gain effected by carrying 50 tons of cargo on board the tug. So that the total saving easily exceeds $7,000 (£1,435) per annum. The tug is but 63 feet long by 13½ foot beam, with 6 foot extreme draft. She is equipped with a single-cylinder Kromhout heavy oil engine of 45 brake horsepower, which uses gasolene* fuel costing 9 cents (0/4½) per gallon. The consumption is under 4 gallons per hour, so the running cost for fuel alone is about 36 cents (1/6) per hour at full speed. The engine-room occupies a space but 14 feet by 13 feet, allowing 38 feet for her length being given over to cargo. The remainder of the space forms the crew's accommodation. Her speed is 7¼ knots.

The first marine Deisel installation carried out by Messrs. Benz, of Mannheim, was the conversion of a 60 indicated horsepower steam tug in 1911, and in the same machinery space there was found enough room to install a Benz-Hesselman motor of 270 indicated horsepower, giving her an average speed of 10 knots. She is owned by Messrs. Strass & Söhne, of Braila, and is used by them on the Donau River. This little craft is built of Siemens-Martin steel and the hull is divided by four bulkheads. *Benz*, as she is named, is 55½ feet long by 13 feet beam, with 7 foot depth, and was built by J. W. Klawither, of Dantzig. Her accommodation includes captain's cabin, deckhouse, galley, engine-room, engineer's and pilot's cabin and the crew's compartment.

These owners have now quite a small fleet of Diesel-driven tugs, including the *Benz*, three others with 270 indicated horsepower motors, and the *Schonlind*, a boat with Benz-Hasselman engines of 345 indicated horsepower at 240 revolutions per minute. These boats haul cargos up to 1,000 tons deadweight between Turn-Severin and Braila on the Donau River.

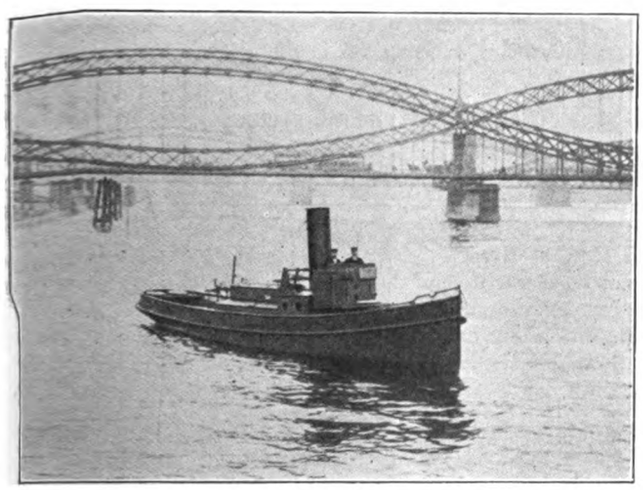


Fig. 4.—Tug Fitted with 80 Horsepower Benz-Diesel Engine

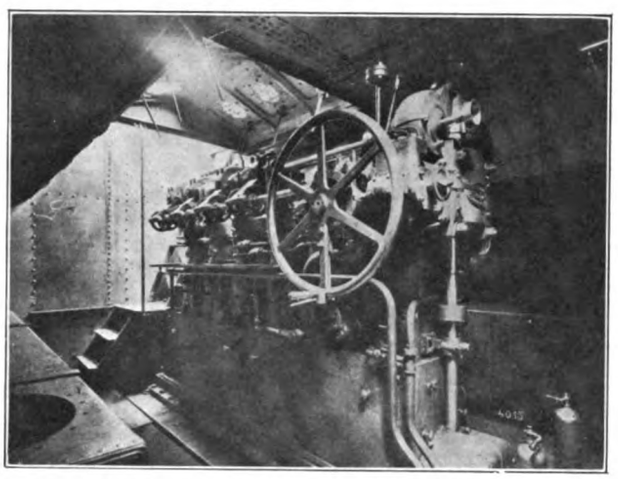


Fig 6.—Engine Room of 100 Horsepower Sulzer-Diesel-Engined Tug

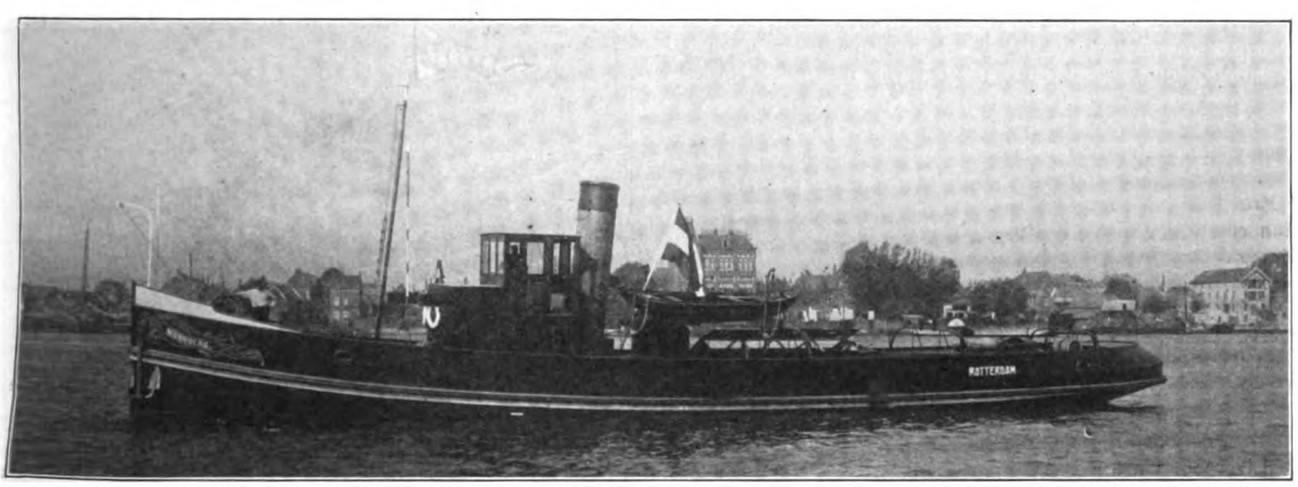


Fig. 5.—A Tug Fitted with a 300 Horsepower M. A. N. Diesel Motor

The *Schonlind* is 84 feet in length by 16 feet 3 inches beam, with 9-foot molded depth and nearly 6-foot draft.

Some important experiments with tar oil as fuel were carried out recently on the new motor tug *Benz* 16, which is in service on the Rhein. This boat is just over 68 feet long by 15-foot beam and is fitted with a two-stroke Benz-Hesselman-Diesel engine of 270 indicated horsepower. In view of the efficiency of the spraying injection valve usually fitted with these motors no alterations were necessary. It was found that with this fuel—tar oil of 8,900 W. E. heating value—the cost was one-fourth that of steam machinery of similar power, and that five times the cruising range was possible for the same quantity of fuel. The average fuel consumption was 175 grammes per indicated horsepower hour.

On the River Rhine there is a large motor tug in service. This is the *Nürnburg*, an 81-foot 4-inch by 15-foot 7-inch boat, built by J. & A. Schuzt, of Rotterdam, and engined by the

* AUTHOR'S NOTE—A totally different fuel from gasoline (petrol).

Generated on 2024-08-12 20:32 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Maschinenfabrik Augsburg, Nürnburg. She is fitted with a six-cylinder reversible two-stroke M. A. N. Diesel engine of 300 brake horsepower and has a speed of 9.1 knots. The pistons are of the stepped type, the larger or lower section forming the scavenging pumps. This is the type of motor that the New London Ship and Engine Company, of Groton, are building under license, and was fully described in this journal some time ago. The tug *Nürnberg* can tow 1,140 tons upstream and 2,400 tons down stream.

In Hamburg harbor two of the many oil-engined tugs in service are equipped with Sulzer-Diesel motors and Fig. 3 depicts one of these small vessels which is doing good service. The other is the *Fortschritt*, a boat 52½ feet long by 15-foot beam and 5-foot 11-inch draft. She is fitted with a four-cylinder two-stroke Sulzer-Diesel motor of 210 brake horsepower, which gives her a speed of 9¾ knots. This engine can reverse as quickly as a steam engine, and, compared with a sister tug driven by steam, there is a saving of engine-room space of one-third, while the weight is one-fourth. In weight 25 percent less fuel is carried, yet she can carry enough oil for eight days' service.

Appointment of New Chief Ship Surveyor to Lloyd's Register of Shipping

The General Committee of Lloyd's Register of Shipping has appointed Prof. Wescott S. Abell, professor of naval architecture at Liverpool University, to succeed the late Dr. S. J. P. Thearle in the office of chief ship surveyor to the society. Mr. Charles Buchanan, who was Dr. Thearle's senior assistant, has at the same time been promoted to the position of principal of the chief ship surveyor's staff.

These appointments are of great importance to the shipping community, not only of the United Kingdom, but also of other maritime countries. At the present moment the tonnage classed by Lloyd's exceeds 22,500,000, 40 percent of which is owned outside the United Kingdom, while the tonnage in course of construction with a view to classification exceeds 2,000,000 tons.

Professor Abell was born in 1877. His professional education commenced in the Royal Naval Engineering College, Devonport, and was continued at the Royal Naval College, Greenwich. In 1900, he was appointed to the Royal Corps of Naval Constructors; from 1904 to 1907 he was professional secretary to the director of naval construction, and for the next three years (following in the steps of the late Sir William H. White and Sir William E. Smith) he held the position of instructor in naval architecture at the Royal Naval College. In 1910 he was selected to fill the chair of naval architecture at Liverpool University.

The professional reputation which he won for himself at a comparatively early age is illustrated by the fact that he was appointed last year by the Board of Trade to be a member of the Load Line Committee, which is now sitting to consider the existing Freeboard Tables, and was selected as chairman of a sub-committee to prepare draft rules for submission to the International Conference to be held later on. Professor Abell's duties in this capacity have involved the investigation of the relation of strength of structure to freeboard and also an exhaustive comparison of the varying rules and practice of the several classification societies.

Among the technical papers which have been read by Professor Abell may be mentioned one on the General Action of Capsizing Forces, before the Liverpool Engineering Society, and one on Methods of Calculation for Investigating the Safety of Ships in Damaged Condition, before the Institution of Naval Architects.

Mr. Charles Buchanan, for whom the office of principal of the chief ship surveyor's staff has been created, has been associated with mercantile shipbuilding throughout his professional career. Prior to joining the service of Lloyd's Register in 1880 he held the position of chief draughtsman with Messrs. A. McMillan & Sons. Later he enjoyed a varied experience in professional work at various shipbuilding ports in the country. Since 1891 he has been stationed in London, holding for the last seven years the position of assistant to the chief ship surveyor. For many years past he has been associated particularly with the duty of dealing with plans of vessels submitted for the committee's approval, and this work has given him exceptional knowledge of all the latest developments of shipbuilding practice throughout the world. Mr. Buchanan has lately been appointed by the Board of Trade to be a member of the Departmental Committee on Bulkheads and Watertight Compartments in Ships.

Gasoline (Petrol) Cruiser for Peru

The Gas Engine and Power Company and Charles L. Seabury & Company, Consolidated, Morris Heights, New York City, have under construction from their own designs a 42-foot raised-deck gasoline (petrol) cruiser for the use of the President of the Republic of Peru. This is the third boat to be built from this design, the other two, the *Vagabond* and the *Spray*, being owned by prominent yachtsmen of this country. The dimensions are: Length overall, 42 feet; beam, 9 feet 6 inches; draft, 3 feet. A four-cylinder four-cycle six-inch by six-inch Speedway 38-48 horsepower motor is installed, which

Motor Boat for Peruvian President

gives the boat a speed of 12 miles per hour. There is a large self-bailing cockpit aft, forward of which is the engine-room, together with the galley and engineer's berth. The cabin itself is 14 feet long, fitted with four extension transom berths. Forward of the cabin is a toilet room. The boat will be lighted by an Apelco electric lighting system.

SHIPBUILDING AND MARINE ENGINEERING IN THE UNITED KINGDOM IN 1913.—According to returns sent to *Engineering* by 124 shipbuilding firms and 93 marine engineering firms in the United Kingdom, 1,204 vessels of a total tonnage of 2,237,000 tons were launched during 1913. The collective power of the propelling machinery built was 2,679,000 horsepower. Including the work done in the Royal Dockyards in 1913, the total tonnage launched during the year aggregates 2,311,960 tons, which is 203,730 tons, or 9.65 percent, more than in 1912, and 223,302 tons, or 10.7 percent more than in 1911. The total horsepower for 1913 given above is 408,000 horsepower, or 18 percent more than that built in 1912, and 437,500 horsepower, or 19.5 percent more than was built in 1911. In practically all of the shipbuilding districts, with the exception of Wear and Ireland, there was a very substantial increase in the tonnage launched in 1913 over that of 1912. On the Clyde the increase amounted to 19.2 percent; on the Tyne, 13.1 percent; on the Tees, 12 percent, and at Hartlepool, 31 percent.

Generated on 2024-08-12 20:32 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

The Twin-Screw Steamship Köningin Luise

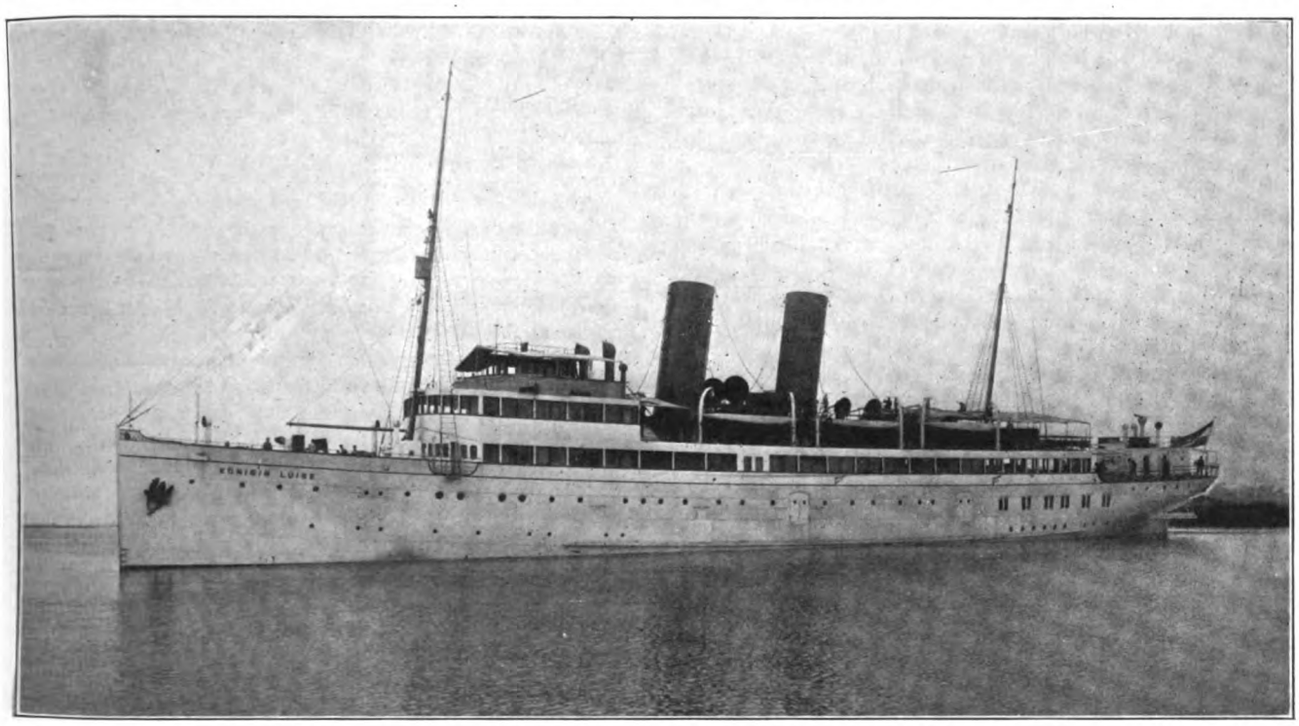
Turbine-Driven Vessel Fitted with Föttinger Hydraulic Reduction Gear—Results from Carefully Conducted Trials

BY F. C. COLEMAN

The twin-screw steamship *Köningin Luise,* built at the Vulcan Works, Hamburg, for the passenger service of the Hamburg Amerika Line has the following leading dimensions:

Length between perpendiculars	275 feet
Breadth, molded	38.62 feet
Depth to promenade deck	23.45 feet
Draft, loaded	9.75 feet
Displacement	1,800 tons

The interesting feature of the equipment of the vessel is the adoption of the Föttinger transformers between the turbines and the propellers, which not only has effected a reduction in speed between them in the ratio of 4.03 to 1, but, when required, reverses the relative direction of rotation, so that while the turbines run continuously ahead, the screw may run either ahead or astern.



Hamburg-American Liner *Köningin Luise,* Fitted with Föttinger Transformers

Boilers

She has three boilers of the Yarrow watertube type, fitted with uptake superheaters and Howden's hot-air forced draft. The amount of superheat is, however, small, being about 60 degrees Fahrenheit. The superheating surface is 300 square feet and the working pressure 240 pounds per square inch.

The total heating surface is	12,220	square feet
The total grate surface is	258.1	" "
H.S./S.H.P.	2.44	" "
S.H.P./G.S.	19.3	" "

There are two independent turbine sets, each designed to give 3,000 brake horsepower at 1,800 revolutions per minute. They are fitted, one on the port and the other on the starboard side of the ship. These turbines are in hydraulic connection with the port and starboard propeller shafting through the Föttinger transformers.

The principal advantage of this system of transmission is that the astern turbine is dispensed with, and consequently there is a considerable reduction in the losses due to an astern turbine, and there is a saving of weight and space. Further, the main turbine can be run at a speed which is practically constant, and in one direction only, so that during maneuvering there is no sudden change of temperature in the steam. In a reversing turbine, which must usually be not much hotter than the condenser, the inflow of boiler steam has a tendency to cause damage. Steam with a considerable amount of superheat can be used without fear of damage to the turbines when the Föttinger transformer is used. Also great rapidity of reversing is obtained by this system and freedom from noise.

Turbines

The turbines in the *Köningin Luise* are of the combined impulse and reaction type, the impulse part being aft of the reaction. Steam nozzles arranged in three groups of twelve each are fitted. Under normal working conditions two groups only are in use, but for extra power a third group controlled by a separate stop valve can be used. The nozzles are arranged circumferentially on the aft end of the casing at a radius from the center line of the shaft of about 2 feet 6 inches. In the impulse part of the turbine there is one Curtis wheel, having two rows of buckets. There are seven expansion stages in the reaction part. The exhaust is led to the condenser from the low pressure end of the turbine through a large exhaust bend.

Generated on 2024-08-12 20:32 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

On the forward end of the turbine shaft a centrifugal governor is mounted which operates a small piston valve in a valve chest, connected by means of a system of piping to a balanced piston valve, which works the main throttle valve for regulating the admission of steam to the main turbine nozzles; the pressure for working this system is obtained from the main feed line. The object of this governor is to control the speed of the main turbine automatically when maneuvering. The throttle can also be worked from the starting platform by means of a hand wheel and rod. The governor also operates the steam throttle valve on the water pressure or makeup pump for the transformer. The speed of the latter pump can also be controlled from the starting platform.

Reduction Gear

Keyed on to the after end of the primary or turbine shaft is the primary water wheel. Keyed on to the propeller shaft are two secondary stage wheels, which are bolted together. The water from the primary wheel delivers up part of its energy to the vanes in the first secondary stage wheel. From here the water is led through stationary guide blades fixed in the casing to the secondary stage wheel, where it delivers up the remainder of its energy, and it is then returned to the suction side of the primary water wheel, where it receives energy by acceleration from the primary shaft, and the operations above described are repeated. Some leakage takes place during the passage of the water at a high pressure. This leakage is made up as is described later.

The primary water wheel is contained in a separate chamber forward of the ahead section, and is keyed on the turbine shaft. This wheel discharges through blades which are fixed in the casing and are set so as to reverse the direction of the flow into the secondary wheel. This wheel is bolted to the first secondary stage wheel of the ahead section and through this is connected to the propeller shaft, which it drives in an astern direction. Owing to less power being required for going astern, sufficient energy can be extracted from the water in one stage, so that there is only one secondary stage wheel in the astern section of the transformer instead of two, as in the ahead. The astern power is about 70 percent of the ahead power.

Governor

It will be seen from the above that when maneuvering the main turbine can be kept running at a constant speed in one direction. This speed is controlled by means of the governor. The makeup pump is of the centrifugal type, having its shaft vertical, and is driven by a small independent impulse steam turbine. The pump chamber is submerged in the tank which supplies the water to the transformer. The pump discharges through the main maneuvering valve into either the ahead or astern portion of the transformer.

Boiler feed water is used for the transformer, and is being constantly heated owing to the work done upon it in the transformer. In order to save this heat and put it back into the boiler, part of the water from the air pump discharge is admitted, through a regulating valve to the transformer tank, and an equal amount is drawn off (by means of a branch in the discharge pipe which leads from the makeup pump to the transformer), and is led to the main feed pump section tank. There is an indicator above the engine-room floor, which shows the water level in the transformer tank, so that it may be seen that the amount of water sent back to the boiler from the transformer is equal to the amount put into the tank. The pressure of the discharge from the makeup pump is about 57 pounds per square inch, and the temperature is usually regulated to about 170 degrees Fahrenheit. In addition to the gain due to saving this amount of heat for the boiler, it is also found that there is a considerable gain in the efficiency of the drive by using water at this high temperature, owing to the viscosity of the water being less than at lower temperatures.

The function of the makeup pump is to replace the water which leaks from the stages of the transformer. The discharge from the makeup pump is led to the transformer through the main maneuvering valves. These valves are placed horizontally, and are of the balanced piston type, worked by a hand lever from the starting platform. The ports in the valve chest are so arranged that when the primary ahead pump chamber is open to receive water the primary astern chamber is open to the drain tank and vice versa. The ports in the valve chest and the ports in the valve are so arranged that both the ahead and astern chambers can be emptied simultaneously (which is what occurs when the maneuvering valve is in its mid-position and the secondary shaft is stopped), but it is impossible to fill both at the same time. The ratio of reduction, i. e., the ratio of the turbine revolutions to the propeller revolutions at which the set is designed to run in this ship is 4 to 1. This ratio can be temporarily increased for maneuvering purposes by slowing down the makeup pump, which causes the water wheel to cavitate. The makeup pressure is regulated according to the desired number of secondary revolutions.

A thrust block is fitted aft of the transformer, which takes up any difference of thrust there may be between the propeller shaft and the secondary stage water wheels in the transformer. There is also a thrust bearing fitted on the forward end of the turbine shaft, to take up the difference between the steam thrust in the turbine and the water thrust in the primary water wheel of the transformer.

Official Trials

During the official trials, carried out between Cuxhaven and Heligoland, the contract speed of 20 knots was obtained with a shaft horsepower of 5,330 on 453 revolutions of the propeller. The vessel left Hamburg at 9.45 A. M. for her trial. At 1:20:44 the telegraph was put full speed ahead. At 1:22 the ship was absolutely stopped; time taken, 1 minute 16 seconds; distance run, not more than two lengths. The revolutions before the telegraph was rung down were 430 starboard and 435 port, corresponding to about 19 knots. The time to reverse the shaft was 8 seconds, and in another, 16 seconds; the propeller was running astern at 320 revolutions starboard and 310 port. These times were taken from the ringing of the telegraph to the moment when the propeller shaft stopped or reached its maximum revolutions astern.

This experiment was repeated at 1:31, the time taken to stop the ship being 1 minute 10 seconds. The revolutions in this case were 430 starboard and 420 port, and the vessel stopped in about the same distance, namely, a little under two lengths. In this case the time to reverse the shaft was 4 seconds. It took 20 seconds more to bring the revolutions to 320 starboard and 310 port.

At 1:44:16 a third experiment was tried. The engines were running about 430 starboard and 410 port. The propellers were stopped in 3 seconds, and were not moved for some considerable number of seconds, when they were put to full speed astern, and in 4 seconds from the time the valve was opened they were running at 370 revolutions. In this case it took 1 minute 17 seconds to stop the ship, but the stopping was done in about a length and a half. It seems as if the immediate reversing of the engines on the stopping of the propellers is not so good as allowing them to go for some seconds without being reversed. The vessel then proceeded to sea and reached Heligoland at 4:55 P. M.

On the way out, between Lightships Nos. 3 to 1, the mean speed over the ground was 20.15 knots. On the return journey the speed over the same distance was 17.5 knots. The average revolutions maintained throughout the whole of the run were port, 420; starboard, 416. The mean speed between the lightships was 18.82 knots, and the revolutions 418 port and 413 starboard. On the way back the revolutions were 423 port and 417 starboard. During part of the run, from 5.0 to 5.15 P. M., the revolutions were 430 port and 425 starboard.

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

HORSEPOWER, WATER AND COAL CONSUMPTION

The mean horsepower, corresponding to the revolutions between the lightships out and home, was 4,480. On the high-speed run, which was not done between these lightships, the shaft horsepower was 4,810, and the revolutions 427½. The speed for this quarter of an hour was not measured, but was estimated to be 19.26 knots.

The water in which the vessel was running was shallow, so that the speed obtained is not a fair measure of the deep-water speed. But as the trial was made to test the economical and maneuvering qualities of the vessel, extreme accuracy in speed is of minor importance.

In these trials the water consumption per shaft horsepower was 12.46 pounds for turbines and gear only, as compared with 12 pounds at full load. Coal was measured on the trial and found to be 1.38 pounds per shaft horsepower (including auxiliaries), as compared with 1.31 pounds at full load. The coal (Westphalian steam) was sampled and tested at the University of Glasgow, and the ascertained calorific value = 12,220 British thermal units, as compared with 13,500 British thermal units on previous trials; thus the coal was of inferior quality.

At 5 P. M. the power was increased for 15 minutes; the average pressure at the nozzles was 181 pounds per square inch, and the mean shaft horsepower was 4,810 at 427½ mean revolutions per minute.

The pressure in the fan cases was about 3½ inches water, in the ashpits 1⅞ inch and in the furnaces ¾ inch. The following auxiliary machinery was working: Three fan engines, 1 dynamo, 2 air, feed and circulating pumps, sanitary pumps and two makeup pumps.

The machinery worked very satisfactorily throughout the three hours, and there was practically no noise or vibration from the transformer when going ahead. Also the results of the maneuvering trials show that this form of transmission is very efficient for quick maneuvering.

At the conclusion of the three hours' trial the ship was stopped in order to see whether the zero position of the torsion meter indicator had moved from that observed before starting. It was found to have slightly altered, and the mean of the two readings was taken as the true zero, from which the shaft horsepowers have been determined. The ship then proceeded up the river and arrived at the Vulcan wharf at 11:35 P. M.

The measurement of the shaft horsepower was taken by means of the Föttinger torsion meter, which measures the angular twist over a certain length of the shaft. The instrument and shaft were carefully calibrated in the shop after the trial, and the assumed constant multiplier for the twisting moment, and also the magnification ratio of the instrument were found to be correct.

The steam consumption was measured by recording the steam pressures in the nozzle used. It is known that the amount of steam which passes a nozzle depends on the size and shape of the nozzle and the pressure and temperature of the steam. This amount can be estimated; but, to have no doubt, the main turbine nozzles were taken from the ship after the trials, and the steam consumption was obtained by calibration of the nozzles. The nozzles were fitted to the exhaust receiver of the condenser in the test house and connected up to the power house boilers. The steam pressure and temperature were measured by the steam gages and thermometer as were used on the trial. The condensed steam was pumped by the airpump out of the condenser and discharged into a measuring tank. Each group of nozzles was tested at three different pressures, each for one-half hour. The results obtained confirmed the results of previous trials witnessed by the Hamburg Baupolizeibehörde.

TRANSFORMER EFFICIENCY

The actual losses in the transformer may be classified as follows: 1. Energy dissipated in fluid friction. 2. Heat lost by radiation. 3. Heat lost by conduction. 4. Friction of bearings, thrust, etc. Of these, the first is by far the greatest. A very complete series of tests was carried out by the Vulcan Company on the starboard set before it was fitted in the ship. The secondary horsepower was measured by means of a waterbrake and the friction and other losses in the transformer were obtained by measuring the amount and rise in temperature of the leakage water from the transformer. The mechanical equivalent of this amount of heat, plus the friction in the bearings, added to the secondary shaft horsepower, gives the primary horsepower. Every precaution was taken to make the temperature and water calibrations as reliable as possible. It was found that the efficiency of the transformer varied with the temperature of the water in the transformer. This is due to the viscosity of the water. The fluid friction diminished at the higher temperature. With the transformer temperature, i. e., the working temperature at 170 degrees Fahrenheit, and at 1,070 shaft horsepower (40 percent of full load), the efficiency, including thrust block, equals 88 percent, from which it may be safely stated that, at 2,700 shaft horsepower, the efficiency would be 89 percent.

THE ISHERWOOD SYSTEM OF SHIP CONSTRUCTION.—The Isherwood system still continues to make rapid progress, and the number of vessels contracted for on this system to date now totals 276, representing almost a million and a quarter gross register tons. The number of vessels built in 1913 shows a considerable advance on 1912, as will be seen from the following figures:

Year	Number of Ships	Tons
1908	2	7,329
1909	8	21,934
1910	25	92,709
1911	40	154,634
1912	52	234,615
1913	79	384,372
	206	895,593

Included in this number are vessels of all types and descriptions, and, apart from ordinary ocean-going vessels, it is perhaps of special interest to note that three other large ore-carrying vessels have been completed for service on the Great Lakes. In the development of the oil tanker the system has played a prominent part, no fewer than thirty-nine of this class of vessel having been launched in 1913. The *San Fraterno*, the 15,000-ton deadweight tanker, built on the Isherwood system, probably created more interest than any other vessel built in the current year, and is the first of twelve similar steamers building on this system, four of which have now been launched. At the present moment about 85 percent of the total oil-tank tonnage building throughout the world is on the Isherwood system, and, up to date, 103 vessels of this type are already built, or are being built on this system in the following countries:

Country	Number of Ships	Tons
United Kingdom	66	382,420
Germany	12	71,408
United States	16	51,672
France	1	3,500
Italy	7	14,000
Sweden	1	5,000
	103	528,000

Vessels have been constructed to the highest classification of Lloyd's Register, British Corporation, Bureau Veritas, Germanischer Lloyd, Norske Veritas and American Bureau, and the system has been adopted by the Governments of Great Britain, the United States and Italy.

Generated on 2024-08-12 20:26 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

The Second Fionia, a Twin-Screw Motor Ship

Ninth Large Motor Ship Built by Burmeister & Wain—Main Engines of the Six-Cylinder Type of Improved Construction Aggregating 4000 Horsepower

The twin-screw motor ship *Fionia,* built for the East Asiatic Company, Copenhagen, by Burmeister & Wain, of Copenhagen, was given an official trial trip in the Copenhagen Sound Dec. 18. This ship has been built to replace another vessel of the same name, which was sold by the East Asiatic Company to the Hamburg-American Line and is now operated by them under the name *Christian X.* The new *Fionia,* however, is a considerably larger vessel and is fitted with more powerful engines.

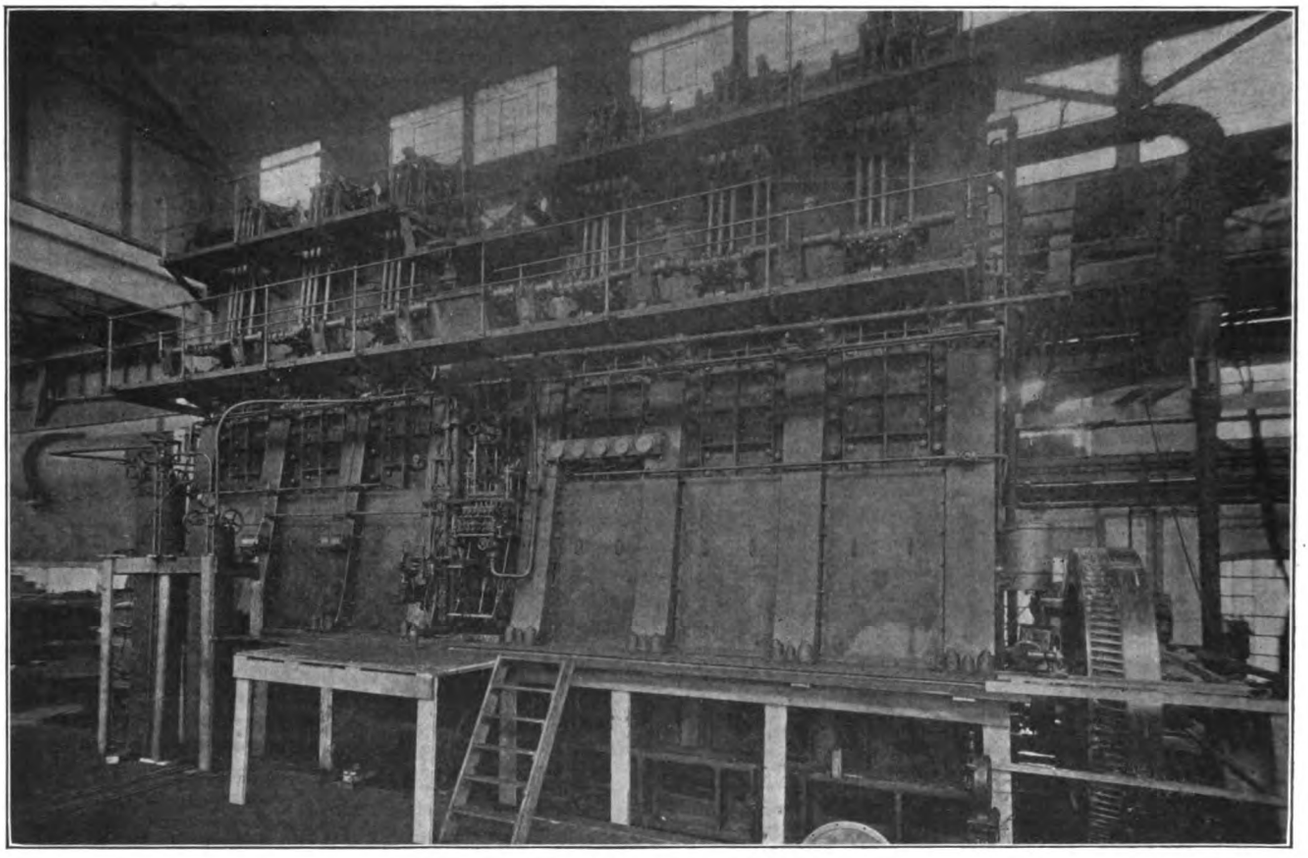


Fig. 1.—One of the *Fionia's* Main Engines

The principal dimensions of the ship are as follows:

Length over all	410 feet
Length between perpendiculars	395 feet
Breadth	53 feet
Depth	38 feet
Deadweight capacity, including fuel oil, about	7,000 tons

The *Fionia* was built for service on the Bangkok route and has accommodations for a small number of passengers. The living rooms and staterooms are splendidly furnished. The deck erection amidships, in which the accommodations are located, is fitted with large sash windows of bronze to provide adequate ventilation in the tropics. The entrance to the main saloon is through a handsome hall finished in birch wood, over which is a dome. The staircase forms a handsome entrance to the dining saloon below. Besides the dining saloon there is a ladies' saloon and music room decorated in white and gold. Above the saloons are special staterooms, each arranged with a dressing room and bath. Aft of this is a smoking room finished in mahogany, and below the smoking room are separate staterooms, each fitted with its own bath. Astern is a hospital, the barber's room and quarters for the servants and second class passengers.

The deck machinery includes twelve electric winches for loading and unloading the vessel, each capable of handling from three to five tons, and an electrically-driven anchor, windlass and steering gear. A wireless equipment is provided and a large refrigerating plant is installed for cooling purposes and for the manufacture of ice.

Main Engines

The propelling machinery consists of two four-stroke Diesel engines, each having six cylinders, with a diameter of 29.6 inches and a stroke of 44 inches. At 100 revolutions per minute these engines normally develop 2,000 indicated horsepower each.

The construction of these engines differs considerably from the construction of the eight-cylinder motors which Burmeister & Wain formerly made. As will be seen from Fig. 4, the bedplate is of the same type as is used in an ordinary steam engine. It is cast with an open crank pit and throughout the whole length below the bedplate is bolted a tray-shaped

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

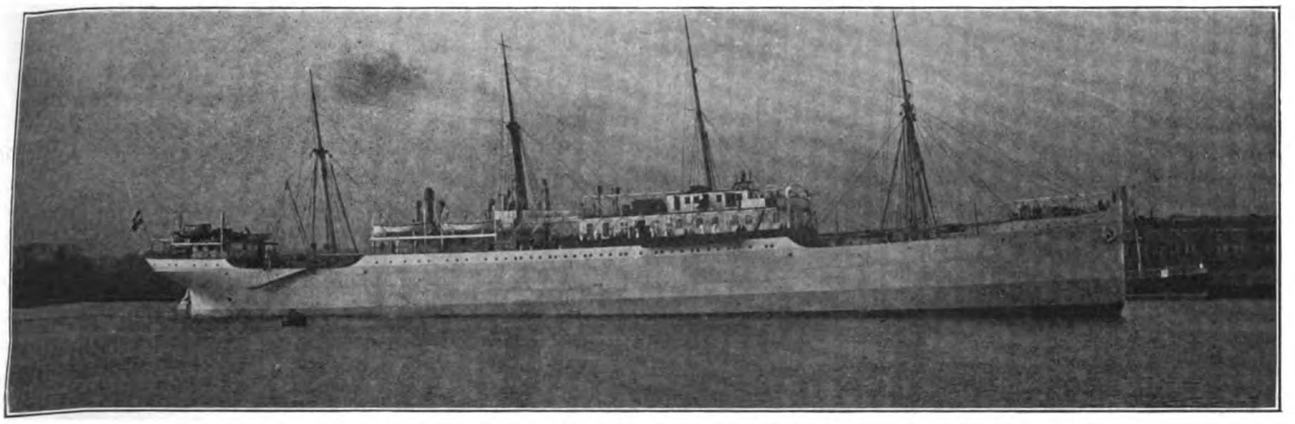


Fig. 2.—The *Fionia*, the Ninth Large Motor Ship Built by Burmeister & Wain

reservoir of welded plates in which the oil is collected. In place of the inclosed casing on which the cylinders were supported in the former motors of this type, the cylinders are supported on separate A-shaped columns arranged so that there is an A-support at each main bearing. These A-columns are stiffly braced, the columns are connected by intermediate pieces and on the top are covers through which the piston rods pass through a very simple stuffing box. The front of the engine is, therefore, quite open, as well as the back of the engine, which is below the crosshead guides. The engine is, therefore, more accessible than an ordinary steam engine. These openings are all covered by easily removable oiltight doors of steel plates. All of the moving parts are thereby entirely enclosed in an oiltight case and are lubricated by forced lubrication.

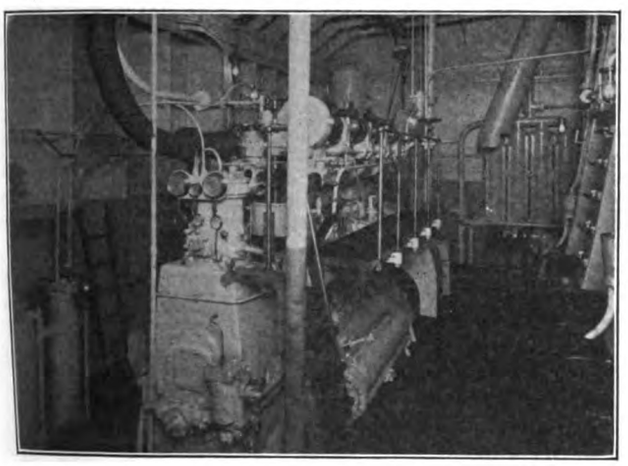


Fig. 3.—Auxiliary Motor

CYLINDERS

The cylinders are cast in two groups, each group comprising three cylinders. The cylinders are secured to the supports by lugs and the cylinders are, therefore, accessible from below, which is a considerable improvement over the previous motors, as this arrangement has the advantage that the cylinder oil dropping down from the cylinders cannot be mixed with the oil used for forced lubrication of the moving parts. The cylinder oil is collected in the tray on the top of the supports and is carried to filters through pipes. Nearly 60 percent of the cylinder oil can be collected and used again after it is filtered.

Heavy stay rods are carried from the tops of the cylinder walls through the cylinder supports to the under side of the bedplate, so that all parts of the cylinder are relieved of tension stresses.

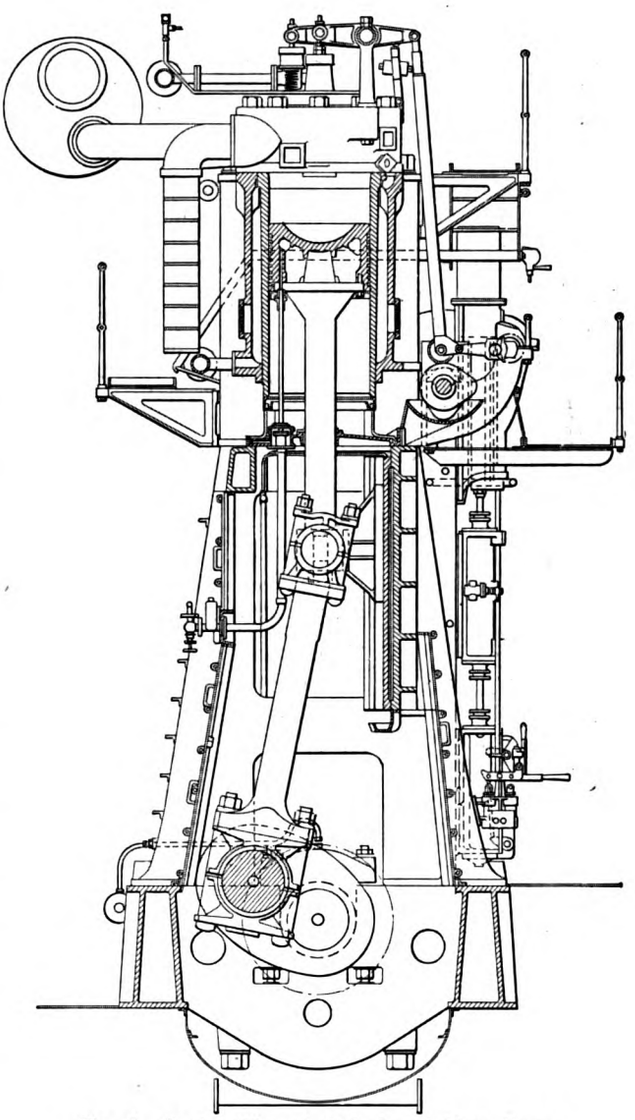


Fig. 4.—Section Through Cylinder of Main Engine

The crank shaft is built up and is bored out as formerly for the admission of oil for forced lubrication. The connecting rods, crossheads and piston rods are all made in accordance with the ordinary marine practice of Burmeister & Wain.

The pistons are cooled by sea water carried to and from the pistons by telescopic pipes, fitted with metallic packing. This alteration of cooling the pistons by water instead of by oil was not undertaken by the builders on account of difficulties

Generated on 2024-08-12 20:33 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

with oil-cooled pistons, but the change has been made because it would have been difficult to cool such large quantities of oil as would be necessary for cooling the large pistons.

Valve Gear

The valve motion is the same as used in the former motors built by Burmeister & Wain, the only alteration being that reversing is not carried out by a rotating air motor, but by a reversing engine of a type similar to Brown's gear. This is worked by the maneuvering air and its operation is both reliable and noiseless. The cam shaft is not driven by connecting rods, as in previous motors, but instead of these two spur gears are used, a design which can be made more accurate from a constructive point of view than the former.

The fuel pumps are driven by levers from one of the intermediate shafts of the cam shaft gear, and one fuel pump is supplied for each cylinder.

Compressors

The compressors for the injection of air are driven from the end of the main shaft and were built by Reavell & Company, Ipswich. In the matter of air compressors this installation differs from that in the motor ships formerly built by Burmeister & Wain, as in the former ships compressors for 20 atmospheres pressure were driven from auxiliary motors, while the main engines were supplied with the single high-pressure compressor, in which the air was compressed from 20 to 60 atmospheres. If this arrangement had been applied to the *Fionia,* with its motors aggregating 4,000 horsepower, it would have been necessary to increase the auxiliary motors to 300 horsepower, and such a motor would have been too large for working the electrical winches. When dealing with such high-powered units the builders considered it advisable to arrange the compressors on the main engines themselves.

The main engines are started by air compressed to 25 atmospheres, which is stored in two large reservoirs, each of 800 cubic feet capacity. This air is taken from the compressors on the main engines, but during maneuvers it is taken from an auxiliary compressor, also supplied by Messrs. Reavell & Company, which is driven by an electric motor of 200 brake horsepower and which can serve as a spare for one of the compressors on the main engines.

Auxiliaries

For working this compressor and for generating electricity for the auxiliary machinery, steering gear, winches, lighting purposes, etc., there are installed two four-stroke Diesel engines, each normally developing 200 brake horsepower at 225 revolutions per minute. These motors are directly coupled to direct current dynamos working at 220 volts, while the current for lighting is transformed to 110 volts. One set is sufficient for working all auxiliary machinery and winches, so that there is always a spare auxiliary Diesel engine.

The auxiliary machinery which is electrically driven consists of two cooling-water pumps, two sets of forced lubricating pumps, two sets of bilge, sanitary and piston cooling pumps, which also handle the cooling water for the pistons. In the case of the pumps, it is only necessary to have one of each set running at the same time, so that the other is held in reserve as a spare.

Annual Convention of Lake Carriers' Association

The annual convention of the Lake Carriers' Association opened at the Hotel Cadillac in Detroit, Mich., on Jan. 21, continuing through the 22d and 23d. Directors of the Association held an executive meeting on the 21st for consideration of matters to be presented during the open meeting of the day following.

President William Livingstone, of the association, opened the convention on Thursday, the 22d, with an address covering the general work of the association during the season of 1913. Speaking upon the great storm which swept the Lakes on Nov. 9 and 10, 1913, Mr. Livingstone said that over $100,000 (£20,500) had been raised for distribution among the families of the 235 men lost during this storm, and that distribution had been made regardless of nationality or without consideration of whether the lost mariners were members of the association's beneficiary plan or not.

His address and report minimized the blame to be placed upon the Weather Bureau for failure to properly warn the vessel masters of the storm, but suggested that more specific warnings be given of the expected violence of an approaching storm.

The figures of the association show that the property loss of vessels ran up to $3,162,900 (£650,000). President Livingstone further urged members of the association to ask the widening of the Livingstone channel in the immediate future, owing to the large number of accidents occurring there since its opening. As is well known, this extremely valuable waterway provided for a down-bound channel for Lake commerce, thus separating the traffic into up and down-bound courses, and avoiding the many disastrous collisions which formerly occurred in this much-congested area of the lower Detroit River a short distance above its mouth.

Attention was also called to the new 400-foot channel between Fighting Island and the Canadian mainland, work upon which is to be commenced by the Canadian Government in the spring, and which will, when completed, permit of further separation of the up and down-bound channels in the Detroit River.

Commenting upon the membership of the association, the fact was developed that there are at present enrolled 446 vessels of all classes, with an aggregate tonnage of 2,026,082 tons, and the season just closed has been the most successful one in the history of the organization.

Further comment was made upon the proposed Wilson-La Follette seamen's bill, and an attitude of deprecation was taken upon it, the view being held that its passage would work great injustice upon both passenger and freight steamers in the United States, as well as imposing some very severe conditions upon foreign ships trading to this country, inasmuch that, as proposed, it practically legalizes desertion.

Commerce upon the Lakes is perhaps better shown by the following statement and figures than could be put forth in a long report:

During the season of navigation of the year 1913 vessel passages on the Detroit River averaged one every 14 2/3 minutes, and during the period of time from April 17 to Dec. 15 (242 days), 13,692 vessels passed the Lime Kiln Crossing at the lower end of the Detroit River. During the twenty-four hours of July 4, 162 vessels passed, which was the season's record for daily passages.

The annual banquet of the association was held upon the evening of the 22d, and practically all of the following day was given over to the meetings of the Great Lakes Protective Association, an organization of vesselmen who have combined into one society to carry their own insurance, and which includes a majority of the members of the Lake Carriers' Association.

In connection with the meetings of this association an interesting display of vessel safety appliances was made, including lifeboat models upon an improved principle, as well as specialties pertaining to both the navigating and engineering departments of steamships, and interesting in degree, as they appealed to the great variety of interests which such a meeting brings out.

Generated on 2024-08-12 20:33 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Control System for the Panama Canal Locks

Power System at Panama—Location and Operation of Locks—Centralized Control and Indicating System and Mechanical Interlocking System

The complete operation of the Panama Canal locks, terminals and auxiliary equipment utilizes electrical energy throughout, with the present exception of the Panama Railroad, the electrification of which is under contemplation. The power system for the operation of the locks, towing locomotives, lights for the locks and buildings, and motors not directly connected with the lock control is composed of:

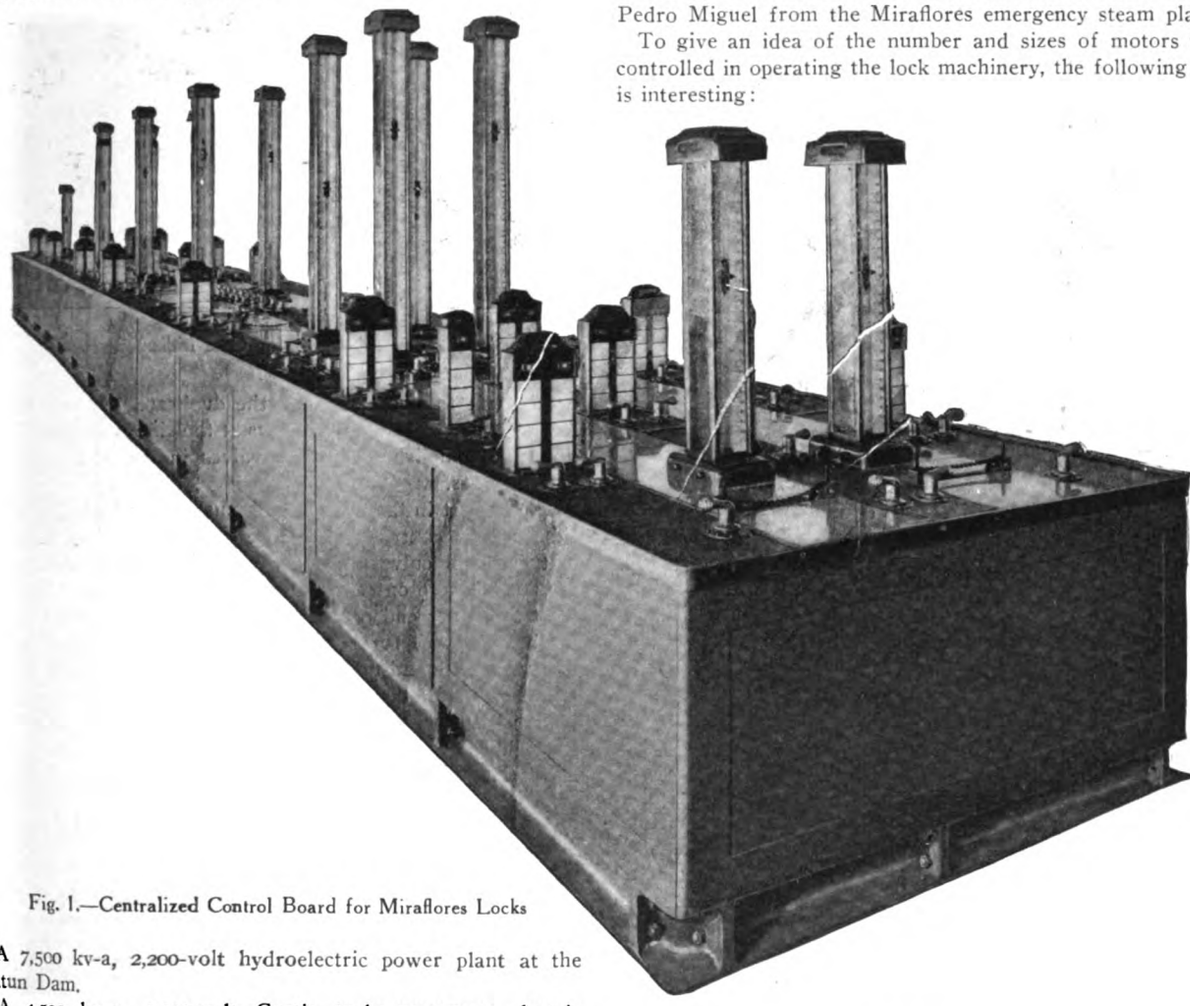


Fig. 1.—Centralized Control Board for Miraflores Locks

A 7,500 kv-a, 2,200-volt hydroelectric power plant at the Gatun Dam.

A 4,500 kv-a, 2,200-volt Curtis turbo-generator electric power plant at Miraflores for emergency, lately used to supply power for construction work.

A double 44,000-volt transmission line across the Isthmus, connecting Cristobal and Balboa with the two power plants.

Four 44,000-2,200-volt sub-stations, stepping down at Cristobal and Balboa, and up or down at Gatun and Miraflores, depending on which of the two plants is supplying power.

Thirty-six 2,200-240-volt transmission stations for power, traction and light at Gatun, Pedro Miguel and Miraflores locks.

Three 2,200-220-110-volt transformer stations for the control boards at the locks.

Stations at Cristobal and Balboa for coal handling plants, machine shops and dry docks.

Current for the lock machinery and towing locomotives is transformed from the 2,200-volt system in the immediate vicinity of where it is used. There are a total of thirty-six transformer stations, for all locks, each containing duplicate 200 kv-a, 3-phase 2,200-240-volt transformers for power and one single-phase 25 kv-a, 2,200-220-110-volt transformer for lighting. The stations, normally fed from the 2,200-volt buses in the 44,000-2,200-volt sub-stations, can also be operated from the power plants; the stations at Gatun locks from the Gatun hydroelectric station, and the stations at Miraflores and Pedro Miguel from the Miraflores emergency steam plant.

To give an idea of the number and sizes of motors to be controlled in operating the lock machinery, the following table is interesting:

Machines and Operation.	Motors each Machine and H. P.	Number of Motors. Gatun.	Ped. M.	Mira.	Tot.	Total Horse-Power.
Miter gate, moving, each leaf..	1-25	40	24	28	92	2300
Miter gate, miter forcing.....	1- 7	20	12	14	46	322
Fender chain, main pump.....	1-70	16	16	16	48	3360
Fender chain, operating valve..	1½	16	16	16	48	24
Rising stem gate valve.....	1-40	56	24	36	116	4640
Cylindrical valve	1- 7	60	20	40	120	840
Guard valve	1-25	6	6	6	18	450
Auxiliary culvert valve.....	1- 7	4	4	4	12	84
Totals		218	122	160	500	12020

There are many motors not included above, as, for instance, those for the spillway gates, for the hand rails on the mitering gates and for the sump pumps.

Location and Operation of Lock Machinery

From an operating standpoint the machinery was placed below the coping of the lock walls, thus affording a clear space

Generated on 2024-08-12 20:33 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

for maneuvering ships and protecting the apparatus from the weather without erecting numerous houses.

The mitering gates consist of two massive leaves pivoted on the lock walls, which operate independently of each other. A pair of gates is located where each change of level occurs and divides the locks into 1,000-foot chambers. In addition to these gates at lake and ocean ends are duplicate pairs of gates used as guard gates. To handle the vessels of various sizes with the minimum use of water mitering gates of the same description as those above are installed, dividing 1,000-foot locks into two compartments. These gates are termed intermediate mitering gates. When the mitering gates are closed they are what might be termed clamped in this position by a device called a miter forcing machine.

Fig. 2.—Water Level Indicator

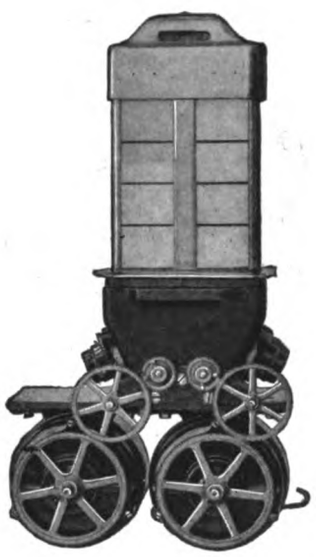


Fig. 3.—Rising Stem Valve Indicator

Chain fenders are stretched across the canal in front of all mitering gates which can be exposed to the upper lock level and also in front of the guard gates at the lower end. These chains are maintained in a taut position when the gates behind are closed, and are lowered when the gates are opened for the passage of a ship. The chains are raised and lowered by a method similar to that followed in hydraulic elevators, with the additional feature that if a ship approaches the gates at a dangerous speed and rams into the chain the chain is paid out in such a way as to gradually stop the ship before it reaches the gates. Lowering the chain for the passage of a vessel and raising it again after the vessel has passed is accomplished by two motors, one driving the main pump supplying water under pressure, and the other operating a valve which controls the direction of movement of the chain. These two operations are combined in one, each motor being stopped automatically by a limit switch when the motor has performed its function.

The filling and emptying of the locks is accomplished by three culverts, one in the middle wall and one in each side wall, the flow of water being controlled by rising stem valves. They are located in the culverts at points opposite each end of each lock so that the culvert can be shut off at any desired point for filling a lock with water from above, or upstream, or for emptying it by allowing it to flow out and down to the next lock. Lateral culverts conduct the water from the main culverts under the lock chambers and up through openings in the lock floors.

The rising stem valves are installed in pairs and each pair is in duplicate; also each culvert is divided into two parallel halves at these valves by a vertical wall. This arrangement reduces the size of each valve and makes it more easily operated, each valve being 8 by 18 feet. One pair of duplicates is left open as a guard, or reserve pair; the other pair is used for operating, so that in case of an obstruction in the culvert or accident to the machinery the duplicate pair can be used. At the upper ends of the culverts at the side walls the duplication is accomplished by three valves in parallel, called the guard valves.

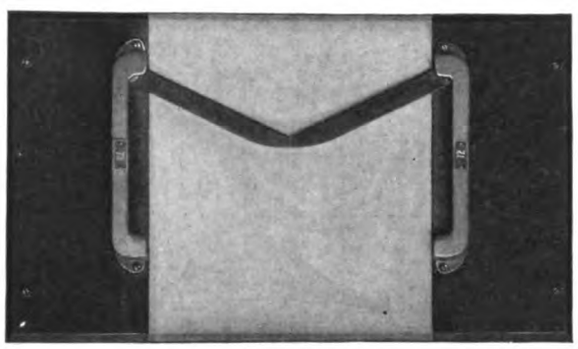


Fig. 4.—Mitering Gate Indicator

The culvert in the middle wall must serve the locks on both sides, and to control this feature cylindrical valves are placed in the lateral culverts that branch out on each side. There are ten of these on each side of the culvert at each lock.

At the upper end of each set of locks there are two valves in the side wall for regulating the height of water between the upper gate and upper guard gate, as it is desired to maintain the level of the water between these gates at an elevation intermediate between that of the lake above and that of the upper lock when the upper lock is not at the same level as the lake. These valves are called the auxiliary culvert valves.

Reasons for Using the Control System Adopted

As the flight of locks at Gatun, for instance, extends over approximately 6,200 feet, and the principal operating machines are distributed over a distance of about 4,000 feet, it can be readily seen that central mechanical transmission of control of machines would be almost impossible; and to control the machines locally would mean a large operating force distributed practically along the full length of the locks, which has invariably been the practice heretofore. Such a force would be difficult to co-ordinate into an efficient operating system. The situation therefore resolved itself into centralized electrical control, which reduces the number of operators, operating expense and liability to accident. To accomplish this system of control a control board for each lock was constructed, which permitted having all control switches located thereon mechanically interlocked, so as to minimize, if not entirely prevent, the errors of human manipulations.

Centralized Control and Indicating System

The control boards are made approximately operating miniatures of the locks themselves, and are arranged with indicating devices which will always show the position of valves, lock gates, chains and water levels in the various lock chambers; and with the exception of such machinery as needs only an

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

"open" or "closed" indication, the indications will be synchronous with the movement of the lock machinery.

For such indication, appliances with commutators, multiple contacts or ratchet mechanisms would not be suitable, because of the many contacts and small pieces in their construction, and particularly because devices of this character move step by step and would not indicate all points in the movement of the main machinery, such indications being more or less approximate according to the number of steps in the indicating devices. The indicators on the Panama control boards were developed especially for this undertaking, and show accurately and synchronously every movement of the machinery to which they are connected, whether in the extremes of travel or at any intermediate point. A complete synchronous indicator consists of a transmitter located at and operated by the machine in the lock wall, and a receiver operating an indicator at the switchboard in the control house.

In the case of the mitering gates, the indicator comprises a pair of aluminum leaves, shaped to correspond to the plan view of the top of the gate, which travel horizontally just above the top of the board, the hinge ends being connected to shafts extending down through the surface of the board, where they are geared to the receivers by means of bevel gears. When the miniature gates are completely opened they are covered by shields to give the effect of the gates folding back into recesses in the lock walls.

For the chain fender, the indication on the board is given by a small aluminum chain, which, like the large chain, is raised and lowered, each end operating independently, the large chain being lowered to the bottom of the lock and the small chain into a slot on the control board. The ends of the miniature chain are fastened to semaphore arms, which are connected to segmental gears meshing with the driving gears on the receiver machines. As the receiver rotors turn, the chain is either lifted or lowered, the position of the large chain from the bottom of the lock being indicated by the angle of the semaphore arms.

As the rising stem valves occur in pairs, their position indicator machines occur in pairs also. Each indicator is similar to a small elevator, a car being used to indicate the position of the valve gate.

Water Level Indicators

The specifications covering the water level indication required an accuracy of 1/20 of a foot or 1/10 of 1 percent in actual water level. The required accuracy was obtained by two sets of transmitters and receivers, one set connected to a fine index in which the rotors make ten complete revolutions and the other set connected to a coarse index operating less than 180 degrees.

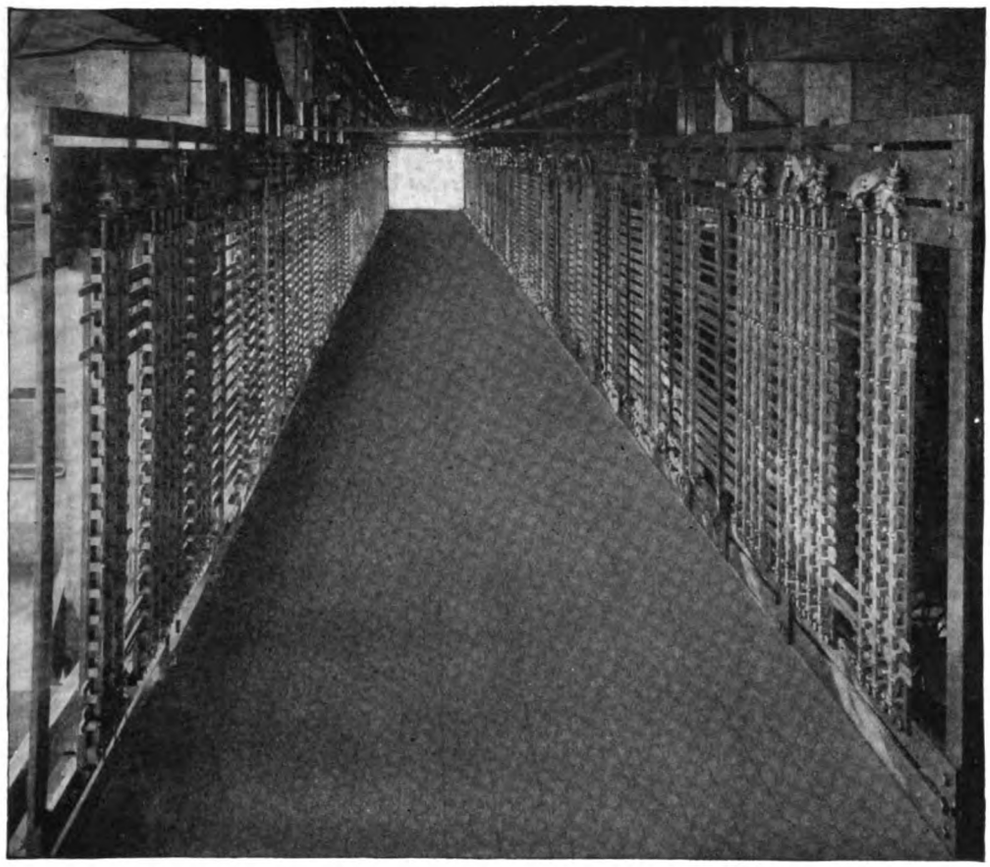


Fig. 5.—View Under Miraflores Lock Control Board, Showing Interlocking Racks

The position of the miter forcing machine is not indicated by synchronous indicators, but its open and closed positions are shown by red and green lights and a mechanical indicator on the control board representing the machine.

Control Boards Represent Locks in Miniature

The control boards are of the flat top benchboard type, 32 inches high by 54 inches wide, built in sections, with total lengths as follows:

Gatun	64 feet
Pedro Miguel	36 feet
Miraflores	52 feet

The side and center walls of the locks are represented by cast iron plates and the water in the locks by blue Vermont marble slabs. The outer edge of the board is surrounded by

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

a brass trim rail, and the sides are enclosed with steel plates, which can be readily removed for inspection of the board. The control board is supported by a wrought iron framework resting on base castings, which are in turn supported on the operating floor of the control house.

The control switch handles are mounted above the surface of the board and operate through an angle of 90 degrees. They are provided with nameplates for the "open," "closed" and "off" positions. The space immediately below the flat top of the control board is occupied by the contact fingers of the control switches, mounted on the operating shaft, synchronous receivers and their cable connections. Connection boards are provided for the cables, which are led up from each side, as are buses for supplying current to the control switches, receivers and the lamps that illuminate the scales of indicators. The receivers, transmitters and lamps are operated at 110 volts, while the control circuits are 220 volts, both using 25-cycle alternating current.

Mechanical Interlocking System

In order to make it necessary for the operator to maneuver the control switch handles always in a certain order corresponding to a predetermined sequence of operation of the lock machinery, and to prevent the operator in control of one channel from interfering with the machinery under the jurisdiction of the operator controlling the other channel, these control switches are provided with interlocks. The interlocks are in two vertical racks under each edge of the board and some distance below, so that they may be inspected and oiled from a floor which is about seven feet below the floor on which the switchboard operator stands. Vertical shafts operated by connecting rods from the control switch shafts extend downward past the electrical parts for the operation of the interlocks. The interlock system is essentially a bell crank mechanism connecting the shaft of the control switch through a movable horizontal bar to a vertical operating shaft, which can or cannot move according to the relative positions of the interlocking bars and dogs.

The interlock system depends mainly on the action of engaging bevel dogs located on horizontal and vertical bars, the movement of a horizontal bar tending to lift a vertical bar by bevels on the dogs. A horizontal bar cannot be moved without raising a vertical bar. Thus, if at any time a dog on a horizontal bar rests against the upper end of a dog on a vertical bar, no movement of the horizontal bar where the dog engages with the vertical bar can take place, and the control handle connected to that particular horizontal bar is locked.

Interlocks prevent the chain fender from being lowered until adjacent mitering gates have been opened, and also prevent the gates being opened until the chain is in the raised position. In this way it is assured that the chain fender will always be in the up position to protect the gate when the gate is closed. To avoid unnecessary complication, each end of the chain is interlocked with the leaf on its side of the lock only, because as a rule both leaves of a gate, as well as both ends of a fender chain, will be opened simultaneously, and further interlocking is unnecessary. After the mitering gates are closed, a miter forcing machine is operated by a control handle and locks the ends of the gates closed. This machine cannot be operated until the gates are closed.

Also the rising stem valves of the side wall, next above or below a miter gate, must be closed while the miter forcing machine is open. As the miter forcing machine cannot be closed until the gates are closed, this means that the valves either above or below the gate must remain closed until the gate itself is closed, thus preventing the operator from creating a current of water around the gates while they are open, or being moved in opening or closing. This interlock is not included on the middle wall valves, for the reason that they will be used with the locks on either side and must be free for that purpose.

Either pair of rising stem valves may be opened first, at the choice of the operator, an interlock becoming effective when the first valve of the second pair of duplicates is opened. This is done by a novel arrangement of equalizing levers acting against the ends of the interlock bars, with certain definite amount of lost motion, which is taken up on opening the first pair of valves, thus putting the interlocks in operation on the next pair.

The Designers and Manufacturers

The specifications for the entire generating, lock controlling and distribution system for operating the Panama Canal were prepared under the supervision of Edward Schildhauer, electrical and mechanical engineer, Isthmian Canal Commission, assisted by a staff of able electrical engineers, including C. B. Larzelere, who was closely identified with the lock control problems, and W. R. McCann with the generation and distribution of power. These specifications exhibited great care and painstaking engineering. They contained every safeguard that expert engineers could suggest, were exact and explicit in regard to the results required, yet gave proper range in the details of accomplishment.

All of the lock machinery motors, control panels, centralized control boards, power station generating apparatus, switchboards, transmission line sub-station equipments, coaling stations and practically the entire electrical equipment for the wharf terminal cranes and for the extensive permanent repair machine shops were manufactured by the General Electric Company.

Westinghouse Reduction Gears for Naval Vessels

The Westinghouse Machine Company, East Pittsburg, Pa., recently received contracts for marine gears for the United States torpedo boat destroyer tender *Melville* and for the cruising gears of the battleships *Pennsylvania* and *No. 39*.

The gear for the *Melville* will have two pinions on the horizontal center line, diammetrically opposite each other, the pinion speed being 1,400 revolutions per minute and the propeller revolutions 110 per minute. The total horsepower transmitted is nominally 2,000 per pinion.

The *Pennsylvania* and battleship *No. 39* will each have two gears, which are connected to the main turbine shafts by disconnecting clutches, the cruising turbines being out of service at full power. Each of the *Pennsylvania's* gears will nominally transmit 1,400 shaft horsepower, and each has two pinions on the horizontal center line, the reduction being from 1,785 to 119 revolutions per minute.

The gears for battleship *No. 39* are also for use at cruising speed only, the speed of the cruising turbines being 2,500 revolutions per minute, and that of the propellers 192 revolutions per minute at cruising speed. The horsepower of each of the cruising turbines of battleship *No. 39* will be 2,000, and in this case a different arrangement of cruising turbines is used, there being only one cruising turbine on each shaft, instead of two as in the *Pennsylvania;* therefore each gear of battleship *No. 39* has only one pinion.

The advantages of the Westinghouse floating frame for automatically maintaining the alinement of the pinions and gear and equalization of the tooth pressures and the compensation of the torsional deflection is rapidly becoming known by engineers, and has resulted in many orders for gears, there now being over 50,000 horsepower under construction and over 50,000 horsepower in operation.

Generated on 2024-08-12 20:33 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Letters from Practical Marine Engineers

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs

Some Trial Trip Experiences

As it has been the lot of the writer to attend a considerable number of trial trips of vessels of very varied types, some of his experiences may be interesting and perhaps instructive. In view of the complexity of modern marine machinery it is surprising that trial-trip mishaps are not more frequent, more especially when one considers how most jobs are rushed at the finish up, although this rushing policy very often illustrates the truth of the ancient adage, "More haste, less speed."

In large vessels it is almost impossible for all the men operating the machinery to be familiar with the pipe connections, so they have to rely very largely on the nameplates attached to the various valves, and misplaced nameplates are a frequent source of trouble. The writer vividly remembers the trials of a certain torpedo boat which affords an example of this.

After leaving the builders' yard and on approaching the measured mile the engines were gradually opened out and the signal sent to the stokehold for "more steam." The reply at once was a demand for "more feed," as the main feed pump was in the engine-room. The pump was speeded up and in a few minutes "more steam" was again asked for to meet the increasing requirements of the main engines. The reply was as before, "more feed." The feed pump was now going for all it was worth, but the stokehold people kept the telegraph going continuously with their demands for "more feed" till they finally signaled "stop."

The engines were stopped, the silent blowoff opened and we hurried up on deck to find the stokehold crowd tumbling out of the scuttles as fast as they were able. They had watched the water dropping in the gages despite their appeals for "more feed" and when it had quite disappeared they had drawn the fires as far as possible, put on the extinguishers, speeded up the fans and cleared out. An investigation was made at once and the cause of the trouble soon located.

A filter was fitted in the feed discharge system with an arrangement of valves whereby the feed water could go through the filter or bypass it, as required. In addition, there was a connection which reversed the flow through the filter and washed any sludge or dirt into the bilges. It was found that the nameplates on the valve controlling the feed passing through the filter and that on the sludge connection valve had been interchanged, with the result that the feed water had been passing into the bilges and was not reaching the boilers at all.

Another case of the same sort occurred on the preliminary trials of a cruiser. The trial had not been long in progress when the feed tank commenced to overflow and all speeding up of the feed pumps failed to stop it. So much water was lost that the trial was abandoned and on investigation it was found that the nameplates on the feed pump suction valve chests had been reversed so that instead of drawing from the engine feed tank the pumps had been taking their water from the reserve feed tanks in the double bottom.

Another case was that of a vessel in which the starting and drain cock gear had all been dismantled during an extensive overhaul. When the overhaul was completed a turn was taken out of the engines and it was found that even with the regulator full open the engines only just moved slowly over the centers. Eventually it was discovered that by some means the "open" and "shut" nameplates at the throttle valve lever had been reversed, the throttle valve in its shut position being sufficiently open to enable the engines to move, although slowly.

By far the commonest result of rushing a job is found in badly made and leaky joints, and the engineers who take some jobs to sea must have anything but a happy time from this cause.

One cause of trouble which sometimes crops up (and which will no doubt be familiar to most engineers) is the omission to cut the center out of a joint.

The writer remembers as an apprentice a case of this kind where the center was left in an insertion joint in the main inlet pipe to the circulating pump. In consequence of this the condenser was so badly cracked on starting up that a new condenser with back columns had to be supplied.

Accidents sometimes occur through articles being left in the cylinders. In most cases a very careful examination is made before closing up the cylinders, but trouble may come in from the steam pipes. An instance of this took place on the trial of a large twin-screw vessel at which the writer was present. When on the measured mile a terrible banging started up in the high-pressure cylinder of the port engine. The engine was stopped at once and as soon as possible the cylinder cover was lifted, when it was found that the piston was smashed. The vessel returned with the power from the other engine to the builder's yard, where the piston was removed and a chisel was discovered in the bottom of the cylinder. Fortunately, the cylinder bottom was intact, so that only a new piston was required.

The chisel had evidently been left in the main steam pipe after jointing it up, and had passed through the regulator valve (the seat of which was damaged) into the high-pressure piston valve. From there it had fallen down the steam passage to the cylinder bottom.

Great care is necessary when fitting out to keep dirt, grit, pieces of waste, etc., out of the system by leaving no open joints, covers or doors. At least these should be left open for as short a time as practicable, for nothing is more annoying than to have to stop a trial for a choked filter or heater, while dirt and grit in the system can do a great deal of damage to cylinders or slide-valve faces in a very short time.

An example of trouble due to "rushing" was that of an engine which refused to run on the morning trial. The trouble was soon located in the air pump, when it was found that the bucket valves had been omitted. It transpired that the night shift had left it for the day shift to do, while the day shift had assumed it done and closed up the pump.

Another incident which has its humorous side occurred on the dock trial of a cargo steamer which was completed in a great hurry. The first trouble was the failure of the vacuum. This was found to be due to the inlet grating being choked, and it was speedily cleared with a steam jet. Other minor troubles manifested themselves in the way of blowing joints, so that everyone was kept busy and worried. The climax came, however, when the reversing gear was run over to the astern position. In their new position the links got right under the middle or packing platform and lifted it bodily off the engine, to the extreme surprise of two greasers who were on it at the time. These gentlemen were deposited on the engine-room plates together with their pots of cylinder oil and swabbing brushes. It may be mentioned that their language, when they recovered from the shock, did full justice to the occasion.

A very annoying instance of the result of carelessness came under the writer's notice on the trials of an oil-fired torpedo

Generated on 2024-08-12 20:26 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

boat destroyer. In one of the stokeholds extreme difficulty was found in keeping a satisfactory oil pressure at the burners. Eventually a spring-loaded escape valve in the oil discharge line to the burners came under suspicion. The escape from this valve was led to the suction side of the pump, and it was thought at first that perhaps some dirt or grit had got under the valve. It was found, however, that there was neither spring nor valve in the case, so that a large proportion of the oil had been simply returning to the suction side of the pump and bypassing the burners altogether.

Mishaps directly traceable to faulty workmanship are seldom met with in connection with the work of firms who have a reputation to lose, but the following incident, which took place on the trials of a small coasting steamer with a single triple engine, may perhaps be placed in this class.

Everything was going smoothly and the vessel had been run once over the "mile," when, without warning, the engine suddenly pulled up. The starting valves were manipulated, but the engine refused to move. It was suggested that the high-pressure slide valve had somehow moved on its spindle, but inspection showed it to be quite secure. The anchor had to be dropped and everyone moved round the engine, trying to locate the trouble, but without result. An attempt was being made to investigate the regulator valve, when the designer of the engine noticed something peculiar about the position of the high-pressure crank, and this soon led to the solution of the mystery.

The round keys securing the crank webs to the shaft had, for some reason, not been fitted, the only security being the shrinking. Thus, after running quite well for some time, the high-pressure crank had slipped forward sufficiently to neutralize the angle of advance of the eccentric—a very simple explanation of what seemed quite mysterious at the time.

The most exciting trials at which the writer has been present were those of naval vessels fitted with high-speed reciprocating machinery. The greatest degree of discomfort was reached with the engines of torpedo boat destroyers. In those days the full power trials of these vessels were of three hours' duration, against the eight hours now required by the British Admiralty. It was, however, a very strenuous three hours and no one who went through them was ever heard to complain about the three hours being too short.

The water service, usually augmented by a hose or two, was in constant operation, so that everyone was soaked to the skin, while the air seemed full of oil and sea water thrown off by the flying gear. The roar of the engines at top speed was rather trying to the nerves, while the vibration, especially when the two engines got into step, made one wonder how the ship held together. In addition, the bilges had a way of quickly filling up, with the result that the aftermost cranks would send a continuous shower of water across the engine-room. Everything depended on lubrication and the slightest failure in this direction usually finished the trial in a shower of molten white metal.

When things happened with these engines they happened quickly. Thus an eccentric strap that had been running quite cool might heat and seize so suddenly that before anything could be done the valve gear would be wrecked and the eccentric rods almost twisted into knots. Although masterpieces of engineering in their way, no one can regret that reciprocating engines are no longer fitted for this class of work.

The conditions imposed by the British Admiralty for the conduct of the trials of the last reciprocating engines fitted to battleships and cruisers were exceptionally severe. A limited number of men were specified to attend to the engines, no water service was allowed and no more oil for the bearings than that supplied by the service lubricators. It can be readily understood that the job of getting naval engines with their high speeds and bearing pressures through an eight-hour trial under these conditions was not always an easy one.

With the adoption of the steam turbine all that was changed and the trials of high speed vessels have become tame affairs compared with the conditions which obtained with reciprocating engines. Thus the writer some time ago attended the trials of a turbine-driven vessel where at one time there were only four men in the engine-room, in which about 30,000 shaft horsepower was being developed. When one considers what the maintenance of a corresponding power with reciprocating engines would involve, one cannot but be struck with the change.

Serious breakdowns with turbines are not common, especially on trial trips, where the men handling them are usually experts. When troubles do occur on a trial they are more frequently in connection with the lubrication or the vacuum. These two are most vital points in the running of turbines.

The slightest failure in lubrication is disastrous, as the writer can testify from more than one personal experience, and it pays an engineer to give great attention to his forced lubrication pumps, so that there is no liability of these pumps to "stick." In addition, the designers who arrange the machinery should endeavor to place these pumps in a position where they can be readily seen and their working observed. The best place is usually close to the starting gear, where the engineer is stationed.

A case which occurred on one of the earlier turbine-driven vessels may be mentioned. A cock was fitted at the oil inlet to each bearing, and in passing into the tunnel (where the space was very restricted) one of the greasers must have knocked against a cock handle, thus shutting off the oil supply to one of the after bearings. In a very short time the bearing ran out and the rotor dropped, thus causing a complete blade strip. With later turbines, however, it is usually impossible to completely shut off the oil supply to any bearing except by a stoppage of the pump.

Economy on a turbine-driven vessel depends to such an extent on the vacuum obtained that careful attention to this point on the preliminary trials may save a great deal of trouble later on. A good plan is to go over all the joints subject to the vacuum with thin red lead paint while they are under vacuum.

Tracing the cause of a low vacuum is often a tedious job and the most obvious places are the escape valves on the condenser and the valve which controls the turbine drain to the bilge. These may be tested with a flame. Another common cause is the leaving open of a drain cock on the exhaust valve of some auxiliary engine, and it is extremely annoying, after hunting round the engine-room for the cause of the trouble, to find it in, say, the open drain cock of the capstan engine exhaust valve. When (as in naval vessels) the closed exhaust system is used it becomes a simple matter to discover an open drain, for all that is necessary is to screw up the spring of the valve admitting the auxiliary exhaust to the condenser, thus putting a back pressure on the exhaust system. With a pressure of, say, 20 pounds per square inch in the system the open drain cock discovers itself.

The mention of the closed exhaust system reminds the writer of an incident illustrating the necessity of familiarity with the various connections which happened on the preliminary trials of a certain naval vessel. On returning to the dock after the trial, "stop" was rung down to the engine-room and steam was shut off the turbines accordingly. Greatly to the surprise of the engineer in charge, the turbines continued to revolve and it was only after some minutes of strenuous tearing round that he remembered about the auxiliary exhaust which was passing into the low-pressure turbine.

In conclusion, however, it must be said that although small but annoying examples of carelessness and forgetfulness are common enough, really serious mishaps are seldom met with on trial trips.

"REACTION."

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Salving the S. S. Penn

The fast day passenger steamship *Penn*, of the Ericsson Line of Philadelphia, burned and sank at her wharf, Pier 4, South Philadelphia, on Sept. 6, and, on account of the light construction of the vessel, the peculiar position in which she lay, and the character of the bottom, the salvage operations were difficult.

The *Penn* and her sister ship, the *Lord Baltimore*, were built by the Harlan & Hollingsworth Corporation, Wilmington, Del., in 1903, for their present owners, for service during the summer months between Philadelphia and Baltimore via the Delaware and Chesapeake Canal. On account of the small width of the canal locks the beam of the vessels was limited.

Their registered dimensions are 196 feet by 23 feet 6 inches by 12 feet. The propelling machinery consists of a 4-cylinder triple-expansion surface-condensing engine, with cylinders 21, 32, 35 and 35 inches diameter by 24 inches stroke, to which steam is supplied at 200 pounds working pressure by four Almy watertube boilers, which are arranged in pairs with a cross-bunker between them.

Fire broke out in the galley of the vessel about 5 o'clock in the morning of Sept. 6, and efforts made to operate the vessel's fire pump had to be abandoned on account of the heat. The flames were finally subdued, however, by two city fireboats, but in accomplishing this sufficient water was poured into the vessel to cause her to sink. Some idea of the difficulties encountered in salving the vessel may be gathered from the fact that 49 days elapsed from the time the work was begun until she was again afloat, although the wrecking company to whom was awarded the contract to raise the vessel agreed to do the work in 12 days.

Salvage operations began Sept. 12, when the wreck was examined by a diver. It was decided to raise the vessel by closing all openings in the main deck except in way of the machinery space, building a cofferdam around the machinery space from the main deck to above the surface of the water, and then pumping out the water within this cofferdam and below the main deck.

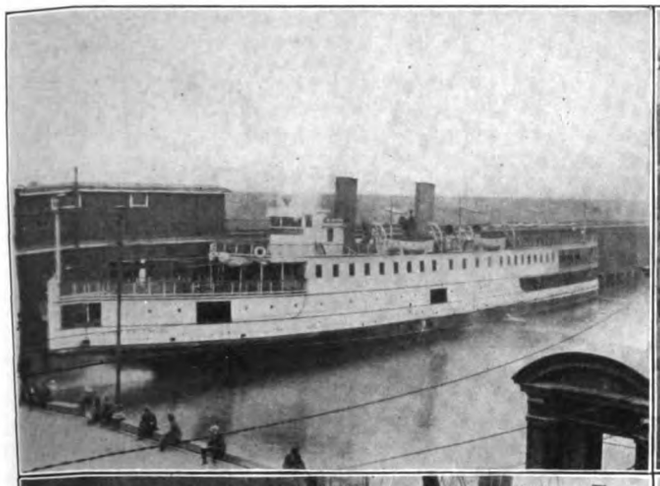


Fig. 1.—The S. S. *Penn*

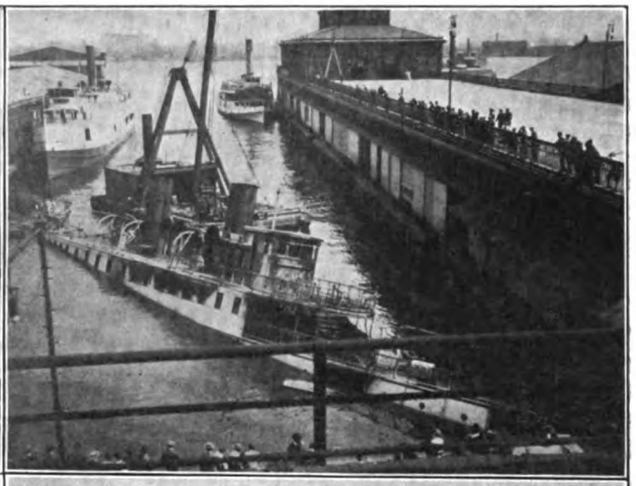


Fig. 2.—Position of the Vessel after Sinking

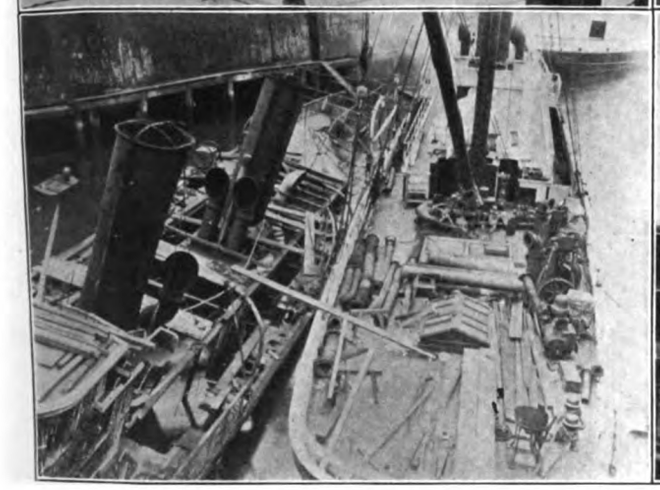


Fig. 3.—Salvage Operations

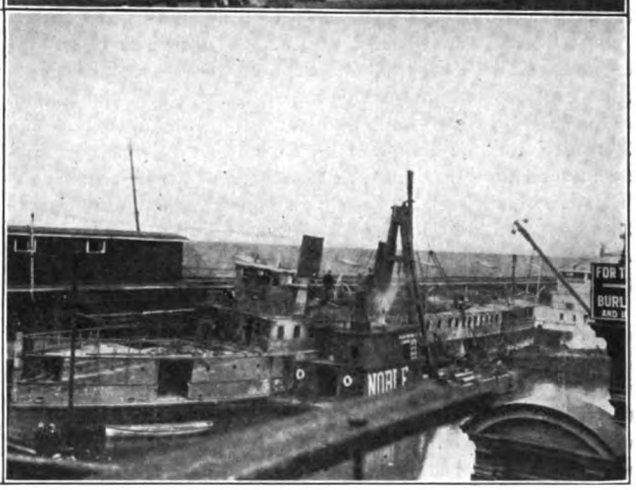


Fig. 4.—The *Penn* Again Afloat

The shade deck was cut away amidships for the cofferdam, and it was also cut away forward of the pilot house for the installation of a pump on the bow. Two duplex pumps were installed in the engine-room near the after end of the cofferdam with discharges over the starboard side, and two centrifugal pumps were installed in the cofferdam forward of the after boiler with long suctions.

The first effort to raise the *Penn* was made on Oct. 17, when the centrifugal and duplex pumps were placed in operation, and a constant pull was maintained on a sling placed around the vessel aft and carried to a wrecking steamer alongside. About 1¼ hours after low tide, however, the water started to come in over the aft port corner of the cofferdam and work had to be stopped. After making various improvements and raising the lower corner of the cofferdam about a foot, another attempt to raise the vessel was made on Oct. 19, but proved unsuccessful.

Generated on 2024-08-12 20:34 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

A third unsuccessful attempt was made on Oct. 20, and a fourth effort was made on Oct. 24, all five of the pumps being operated and with the wrecking steamer exerting a pull at the stern directly on the port side. As the result of this attempt the bow came up several feet, but the stern remained fast, so on the next day an additional centrifugal pump was installed forward of the others in the cofferdam, and on Oct. 26 the fifth attempt was made, with all six pumps operating, and with the wrecking steamer and a wrecking lighter exerting an upward pull aft.

A sixth attempt to raise the vessel failed on Oct. 27, and another centrifugal pump was placed in the aft port corner of the cofferdam. With all pumps working and the two lighters pulling up on the port side a seventh attempt was made on Oct. 30, with the result that for the first time the stern was raised, but when it left the bottom the vessel started to turn over to port, notwithstanding the upward pull on that side, and the attempt had to be abandoned.

The eighth and successful attempt to raise the vessel was made on Oct. 31. The conditions were the same as on the previous day, except that the bow was not allowed to come up so high. Fig. 4 shows the vessel after she was again afloat.

Philadelphia, Pa. SURVEYOR.

Strength of Columns

The November issue of INTERNATIONAL MARINE ENGINEERING contains a reply by Mr. Anderson to a criticism which I was led to make in a previous issue regarding the validity of the Moncrief formula, together with a counter-criticism of a column formula suggested by myself. I believe that Mr. Anderson should be credited with the motive of wishing to remove any misconceptions existing with respect to the column tables, for which he stands sponsor. It seems strange to me, therefore, that he should have so entirely misread or misunderstood the reasoning in the articles which he criticises.

Mr. Anderson's stricture centers upon the method of eccentrically applying the load to a column, and on the existence or non-existence of reactions at the head and foot of the column induced by such a load. The present explanation will be made clearer by reproducing a part of his first figure (Figs. 1 and 2).

At the outset, let me say that my formula assumed the kind of loading depicted in Fig. 1, only Mr. Anderson omitted the reactions which I have indicated by the broken line arrows, which then makes the figure identical with Fig. 1 of my previous article.

Consider the stability of the column shown in Fig. 1. Can there be any possible doubt that for the equilibrium of the column acted upon by the forces indicated we must have

$$F \times L = W \times e$$

where F is the magnitude of the induced equal and opposite reactions at the head and foot? Yet Mr. Anderson says that this condition neglects the resistance to bending of the column itself as a part of the static conditions producing equilibrium. It should surely be obvious that the resistance to bending, and all internal reactions, have nothing whatever to do with, and have no influence upon, the equilibrium of the external forces.

In my article I claimed that there must, in general, be reactions at the head and foot of an eccentrically loaded column. To quote verbatim: "As unless the load was applied through the pins and those were not only eccentric, but by a miracle of chance lay in the same vertical line, there would be lateral reactions at the pins." Now Fig. 2, which illustrates the method of applying the load adopted by Moncrief, obviously assumes that the miracle has been performed. It never occurred to me that under these conditions there could be any lateral reactions at the pins. I think that anyone could see at a glance that unlike the case of Fig. 1 there are no unbalanced external forces, and therefore no reactions are required to be induced to bring the system to equilibrium.

Your correspondent thinks there might be a lingering doubt about this point, and covers half a page with a mathematical argument upon the subject. Unfortunately, however, the argument is based upon the internal bending reactions of the

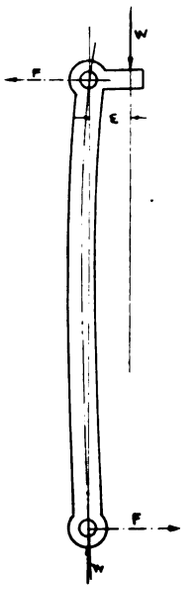


Fig. 1

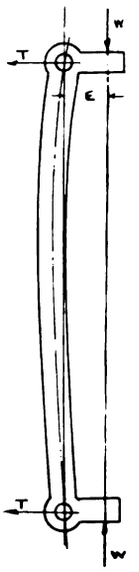


Fig. 2

column, which have not the slightest relation to the matter. If Mr. Anderson was to apply the two forces "*T T*" shown in his figure, what would happen is, that the column would begin to travel sideways with a velocity depending upon the magnitude of the forces.

"*T T*."

There are, in fact, in my article no misconceptions whatever regarding the reactions. The difference between the formula of Moncrief and that suggested lies in the way the

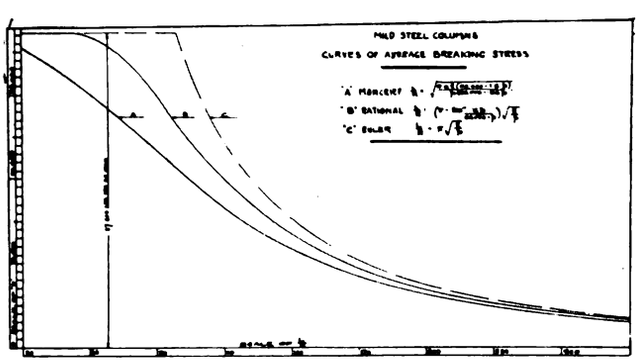


Fig. 3

load is applied, and it is here that I consider his premises to be misconceived.

Mr. Anderson claims that the method of applying the load used by Moncrief gives the worst condition. To bring in the conception of worst conditions in this case leads to a fallacy. There can be no question of worst condition, as the breaking load is compared with experiment and the magnitude of the eccentricity adjusted to make the formula agree with experiment. The question is, which method the more nearly represents actual conditions?

It seems to me that in practice there is sure to be a want of alinement of the actions of the loads at the ends. Now Moncrief has assumed that there is a perfect alinement, for the

Generated on 2024-08-12 20:33 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

purpose no doubt of eliminating these very reactions discussed above. It does not appear that this avoidance of the terminal reactions simplifies matters. Moncrief assumes an arbitrary form for his curve of elastic deflection:

$$Y = \frac{W L^3 \epsilon}{8 EI - 5/6 W L^2} \left(\frac{L^2 - 4 x^2}{L^2} \right) + \epsilon$$

The symbols have the usual meaning.

Had Moncrief determined the curve of elastic deflection for the premises he himself assumed, the expression would have been

$$Y = \epsilon \left(\text{Cos } nx + \frac{1 - \text{Cos } nL}{\text{Sin } nL} \text{ Sin } nx - 1 \right)$$

where

$$n = \sqrt{\frac{W}{EI}}$$

The corresponding curve in the proposed formula, which included the indicated end reactions, was

$$Y = \epsilon \left(\frac{\text{Sin } nx}{\text{Sin } nL} - \frac{x}{L} \right)$$

which is simpler in form.

In practice and especially in ship work there is sure to be a more or less want of alinement. If there was no eccentricity there would be no alteration in the bending movements, due to the forces not being in line, as the direction of the resultant of the load and pin reactions would coincide with the axis of the column; but where there is eccentricity of loading the pin reactions will modify the bending movement, as previously explained.

The usefulness of a column formula based upon a conceived eccentricity of loading depends upon *the possibility of making the curve of breaking loads, as represented by the formula, agree with the curve of breaking loads determined by a wide range of experiments, by means of giving to the eccentricity factor a certain fixed value.* The form of the breaking load (unit average load) given by the formula

$$\frac{l}{p} = \left(\pi - \text{Sin}^{-1} \gamma \frac{p}{f - p} \right) \sqrt{\frac{E}{p}}$$

was found to agree with a large number of experimentally obtained curves to a remarkable degree. In Europe, it is still customary to use Euler's Formula for columns, i. e.,

$$\frac{L}{\gamma} = \pi \sqrt{\frac{E}{p}},$$

for loads less than that which would cause the material to fail by pure crushing. Euler's curve, together with Moncrief's and my own is shown in Fig. 3. It will be seen that the Moncrief formula supposes the bending effect to be influential, however short the column, while my own curve lies between this evident extreme and that of the sharply defined change point given by the Euler curve.

So much for the basic formulæ. The real object is to derive suitable column tables. Truth compels me to say that the present tables are far from satisfactory. In the first place, I think it was an error to base the constants upon the lower limits of the experimental data, instead of averaging these in the orthodox manner. This I take to be the initial error, and it looks as though to "get back" a peculiar juggling of the factors of safety had been resorted to. The nominal factors of safety given over each column are really 10/6 times the ordinary breaking load factor in common use. This is justified by stating that, keeping in view the curious manner of comparing the empirical formula with experimental data, the nominal factor of safety of the column would coincide with the true factor of safety of a tension member worked into the same structure. To use a Scotticism, the tables as they now stand are "neither fish, fowl, or guid red herring."

Assuming for the present that the Moncrief formula can be taken as a more or less satisfactory basis, then it would require only a little time to unwind the mechanism of false hypotheses and make the tables explicit. Others have found the same difficulty as myself when attempting to use these tables.

In conclusion, I do not pretend that the proposed column formula is free from fault; for instance, while the method of applying the load takes account both of eccentricity and of want of alinement, it is not the general case. The general case would, I believe, present no advantage, while being much more complicated.

ATHOLE J. MURRAY.

A Novel Experience

A gunboat of the United States Navy was steaming full speed up the Amazon River shortly after the Spanish War, when a holding-down bolt of the after main bearing of the starboard engine carried away. The ship had left Manoas, which is 800 miles up the Amazon River from Para, for Iquitos, Peru, which is 2,500 miles from Para. An English tramp steamer also left Manoas at the same time for Iquitos and a race commenced between the two ships up the river.

The current of the Amazon runs at a speed of about four knots and large trees and logs were found floating down the river and occasionally the propeller blade would come in contact with a floating obstruction, with such force as to cause a heavy jar on the engine. At other times the ship would strike a glancing blow on a partly submerged object and cause alarm and apprehension in the minds of the crew as to how much damage had been done.

The two ships raced along night and day with varying success, sometimes with one ship in the lead and then again the other would have the advantage. What would sometimes appear as only a small distance separating the ships when rounding bends in the river would be a considerable distance when the ships got on a straight stretch of the river, and the excitement ran high as the ships would pass and repass each other. When the main bearing bolt broke the American ship was in the lead, with the engines making about 200 revolutions per minute.

One engine was kept going while an attempt was made to back out the broken bolt, but without success. It would also have taken some time to make a new bolt and it would have to be machined, no taps and dies of that size being at hand. The breakdown happened about 10 A. M. and the tramp steamer passed the American ship at noon, at this time making only seven knots with one engine. The end of a tow line was waved from the stern of the tramp steamer as she went by, an exultant grin on the face of the English sailor proffering the mock help.

In the meantime a one-inch hole was drilled down with the broken bolt and tapped to receive a one and one-eighth-inch stud. The bearing was replaced, a shore put under the cylinder to assist in making the job secure, and then ahead full speed on both engines.

At night the English steamer could be located by the flame pouring out of her stack. At midnight she was passed, after much jockeying for the right of way on the course and only after she made desperate efforts to keep the lead. The following morning the race ended with the American ship the winner, arriving about thirty-five minutes ahead of its rival.

Philadelphia, Pa. J. E. CLEARY.

Generated on 2024-08-12 20:33 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Marine Articles in the Engineering Press

The German Institute of Naval Architects, No. I.—The first paper read at the fifteenth annual meeting of the German Institute of Naval Architects, held recently, was entitled "Recent Experiences and Improvements in Marine Turbine Construction," by Dr. Bauer, engine works manager of the Vulcanwerke, of Hamburg. Dr. Bauer pointed out that while the aggregate horsepower of marine turbines built in Germany up to the end of 1906 was only 97,000, it would at the end of 1913 reach about 3,200,000. Under these circumstances lengthy experience was lacking, and many strippings of blades had occurred. These mishaps were attributed to unsuitable material, to the choice of blade proportions that facilitated bending, and to the design of the general installation, which necessitated sudden reversals. The growing tendency to increased blade clearance was emphasized as being favorable to safety in this respect, particularly if superheated steam were used. The best way to cure blade stripping was considered to be to avoid reversing the direction of rotation of the turbines, and great importance was attached to the staying of the blades so as reciprocally to support each other. Blading difficulties caused the speaker to support the adoption of the quick running indirect acting turbine, with its few blades, in place of the many-bladed direct-acting type. Quick running-geared turbines, it was maintained, would cause large reductions in cost, installation, space and weight. In comparing gearings on the toothed wheel and on the Föttinger transmitter systems, Dr. Bauer stated that while higher gear ratios and higher efficiencies could be obtained with the first method, superior reversibility and greater reliability of the mechanism were found in the hydraulic system, which provided also the possibility of developing large powers without dividing up the engine into a number of units. The percentage of engine power available for stopping a vessel fitted with the Föttinger transmitter was given as 70 to 85 percent, while that with the direct-acting turbines was set at from 35 to 45 percent only. Dr. Bauer looked forward to the use of superheated steam for installations of large power. With it and with revolutions of about 1,600 per minute, geared down to 250, a saving of about 25 percent in coal consumption would be obtained. In discussing the paper Herr Roth stated that the material used for turbine blades now in general use had been employed in many cases from the very beginning of the use of turbines, and that it was hard to account for blade strippings on the score of faulty material. Superheating was considered by Herr Roth to be an application in ship work that was undesirable. He admitted that the astern turbine was the weak point in turbine installations, but declared that suitable means had been adopted to prevent the vibration of blades, and had given good results. Dr. Bauer's assertion, that blade strippings were only caused by the reversing of the astern turbine, was absolutely contradicted. Herr Roth also favored toothed gearing, as against the transmitter system. He stated that the time required to stop a vessel fitted with reciprocating engines had hitherto been in all cases attained with direct turbine propulsion. Captain Frommann, of the German Navy, discussed the paper from the point of view of the commanding officer on the bridge with reference to the question of the maneuvering. Referring to the trials of the Föttinger transmitter system, he stated that all who had been present at its trials had seen that its maneuvering qualities were quite unsurpassed. The German naval officers were satisfied with the turbines, but, nevertheless, the stopping distance was greater in turbine ships than in the older vessels with reciprocating engines. Herr Schulthes commented favorably on electric transmission. Herr Boveri absolutely denied what Dr. Bauer had said about the astern turbine. He could not find any great difficulty in the astern turbine, but he stood on the same ground as Dr. Bauer in believing that they were on the threshhold of a change from direct to indirect propulsion, first, because of the enormous dimensions of the large turbines, in which the limit of size was reached with diameters of 5½ meters and weights of 400 tons, and, second, because the efficiency attaching to the slowly-running propellers had not been attained in direct turbine ships. He was of the opinion that from a technical point of view the toothed gearing enabled the problem to be completely solved. Direktor Eggers fully agreed with Dr. Bauer, that the natural development of turbine building lay in the direction of the elimination of the astern turbine, in gearing down and in superheating. In fact, the way seems to be open for the application of the watertube boiler with high-pressure and a high degree of superheat to merchant vessels, as well as to naval vessels, opening out excellent prospects for the reciprocating engine as well as for the turbine. Direktor Regenbogen expressed the opinion that the transmitter appliance would bring advantage only after its astern turbine had been given up and the astern turbine had been reintroduced. 4,500 words.—*The Engineer*, November 28.

The German Institute of Naval Architects, No. II.—The second paper read at the fifteenth annual meeting of the German Institute of Naval Architects was the "Development of the Submarine Boat Periscope," by Dr. Weidert, of Friedenau, Berlin. The author traced the development of the appliance from its first application to its present development, giving a comprehensive description of the various details which have been introduced to bring the appliance to its present state of usefulness and efficiency. The next paper read was on "Analogies Between Airship and Seaship Building," by the late Felix Pietzker, of the German Admiralty. The paper contained a popular description of the different types of airships and showed where points of contact occurred between them and ships that sail the seas. He showed that the airship had most resemblance to a submarine boat. The various existing types of airships were described and compared. The fourth paper discussed was by M. H. Bauer, naval architect, of Berlin, on "Harmony in the Forms of Vessels." The paper was practically a discussion of the question, "What Is the Simplest and Most Favorable Form of Vessel for Given Values of Length, Breadth and Displacement?" After a discussion of lines of various ships he finally adopted a system of sinoid and sinoid-like curves ranging in fullness from .5 to .666 for the ends of vessels, which, in combination with ordinary lengths of parallel middle body, give coefficients of displacement up to about .78. For the relation borne by the fullness of the load waterline to that of the displacement and that of the midship section, he gave a formula $\alpha = .7 \times \frac{\delta}{\beta} + .3$, in which α = coefficient of load waterline, δ = that of the displacement, and β = that of the immersed midship section. Results from the formula as applied to twenty-four vessels of widely differing types showed a remarkable agreement with the usual value. The author expressed the conviction that a geometrical treatment of a ship's lines, as attempted by Scott Russell and others, was by no means impossible, and that its application for the determination beforehand of the qualities of vessels could be made to give useful results. Baumeister Schlichting pointed out that the influence exercised by the element of form effected the displacement and the stability more than the resistance. 3,000 words.—*The Engineer*, December 5.

Generated on 2024-08-12 20:33 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

German Institute of Naval Architects, No. III.—On the second day of the fifteenth annual meeting of the German Institute of Naval Architects, Dr. Ing. W. Thele, of Hamburg, read a paper dealing with Hamburg dredging methods. The author traced the development of the methods and apparatus applied to the deepening and training of the River Elbe from the beginning of the last century up to the present time. A turning point in dredging practice in Hamburg was the advent of the barge suction apparatus in 1900. Each vessel was provided with a centrifugal pump for transferring material through a pipe line of several hundred yards to the shore. A second centrifugal pump was used to soften the ground and facilitate the suction operations. The Hamburg dredging plant included about 300 vessels, 65 of which were provided with steam engines and boilers, and employed about 1,000 men, including 76 officials. The next paper dealt with spark telegraphy on the *Imperator* and was read by Direktor Bredow, of Berlin. The author sketched the development of German wireless telegraphy and showed that in the race between the different systems it took a good second place to that of Marconi. The two together probably did about three-quarters of the entire work of the world. The paper was taken up mainly with the description of the wireless station on the *Imperator*, which is the largest and most powerful one installed on any merchant or passenger vessel. It comprises three arrangements of antennæ, two receiving stations and three transmitting devices capable of covering distances of 3,000, 1,200 and 400 kilometers, respectively. The apparatus is so arranged and duplicated that a part of it would be available and in working order in spite of any of the known mishaps that might reasonably be anticipated. The next paper was on the screw propeller problem by Dr. Ing. Gumbel. The paper was practically a book of over 100 pages, in which the author showed that the fundamental equations for the screw propeller corresponded with those for the turbine, the action in one being the inverse of that in the other. The condition of the flow of water in front of, behind and in the propeller and the resistance opposed to this flow were examined by the aid of equations. The assumptions made on the basis of a general consideration of the problem were then compared with the results of experience obtained in the course of propeller experiments and were found to be in complete agreement with them. A point to which the author drew special attention was that by the application of the principles laid down in the paper comparisons between propellers greatly varying in design became possible. In discussing the paper, Herr Schaffran mentioned the fact that in tugboats the broad-bladed propeller with uniform pitch was the best. He warned the meeting against transferring the conditions of one propeller to another, for enormous differences were produced by very slight alterations. The next paper was by Herr Ludwig Benjamin, of Hamburg, on the "Measure of Stability Necessary for Ships," in which he said that the measurement of stability by G. M. height was well known to be unreliable. After examining a large number of curves of levers and curves of dynamical stability of vessels of different types and sizes, he came to the conclusion that the latter gave the more convenient and reliable indication of the capabilities of the vessels selected to withstand the various heeling forces that might act upon them at sea. He proposed to establish minimum values of dynamic stability at 30 degrees and 60 degrees, and endeavored to show that these values insure the presence of stability, even when the G. M. height was made zero. This paper was followed by another on the "Importance of the Measurement of the Stability of Seagoing Ships," by Dr. I. Carl Commentz, of Hamburg, who had made experiments on board the *John Sauber* and other steamers to ascertain how far it would be possible to keep records of the stability conditions of vessels during their voyages. An instrument designed to enable measurement to be made of the angles of inclination due to the heeling of a vessel by the shifting of a known weight through a given horizontal distance was illustrated and described. Experiments with the instrument had been made by the captains of several steamers at sea, and the results had shown that with suitable inclining appliance quite sufficiently accurate results could be obtained in moderate weather and with moderate degrees of rolling. With appliances of this class, Herr Commentz considered that the captains would be able to exercise constant control on the initial stability of their vessels, and therewith of the positions of their centers of gravity. The instrument could also be used in determining the importance of list and of longitudinal trim of a vessel. 4,600 words.—*The Engineer*, December 12.

Steam Trawlers.—The first steam fishing boats were built in France in 1865. Little headway was made in the development of this type of boat until Great Britain, followed by Germany, entered the field. In Great Britain the first attempts at steam trawling were made on tug boats belonging to Tyne and Wear owners. The early trawlers were generally from 80 to 90 feet long, of small displacement. At the present time, however, much larger boats are used for this service. Modern steam trawlers may be divided into three classes: Small vessels, 90 feet to 110 feet long, intended for North Sea fishing; medium sized vessels, 110 feet to 130 feet long, also intended for North Sea fishing, but with equipment for extended voyages, and large vessels, 130 feet to 170 feet long, designed for long voyages to distant fishing grounds. Examples of these various classes are described in detail and illustrated by drawings and photographs. The scantlings of a trawler are usually from 10 to 20 percent in excess of Lloyd's requirements for an ordinary vessel of the same size. The trawling appliances on board the ship include the trawl winches for winding in and out the drag ropes, the deck fairleaders for the drag ropes, the gallows from which the otter boards are suspended when raising or lowering the net, and the towing bollards or blocks, to which the drag ropes are made fast when a sufficient length has been paid out. The arrangement and construction of these appliances are described in detail. 13 illustrations. 2,250 words.—*The Shipbuilder*, December.

The Ventilation of Modern Battleships.—By Naval Constructor R. D. Gatewood, U. S. N., and Surgeon Charles W. Oman, U. S. N. In the matter of ship ventilation the force of gravitation is the first aid to be sought. The use of electric lights has been an enormous aid in ventilation, as they add a comparatively small amount of heat and consume none of the oxygen in the air. Advantage has also been taken lately of the fact that a powerful circulation of the air in a compartment can produce results equivalent to a considerable supply of air even though no air is actually supplied to the compartment. For this reason the present unsatisfactory ventilation condition in certain fire and engine rooms would be very largely overcome by supplying a large number of ordinary circulating fans for these compartments. The present practice in designing a suitable system of ventilation for a battleship is to investigate the quantity of air required for each compartment based on the rate of change, as determined by experience for similar compartments in previous vessels, and simultaneously to investigate the amount of air required based on the number of occupants of the compartment and the character of the work customarily performed in the compartment. From these two that one is selected which calls for the larger amount of air. The ventilation of the U. S. S. *Wyoming* is described as an example. The system employed on this vessel, termed the "direct contact and ventilating system," was first tested by the navy on the U. S. S. *Vermont* in 1906 and has been extended to all ships since the *Utah* class. In general the system consists of 34 separate fans, including exhaust and supply. Air is drawn in from numerous mushroom cowls,

Generated on 2024-08-12 20:26 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

ventilators and trunks, located on the main and superstructure decks. Distributed over the third deck are 12 thermo-tanks forming part of the air ducts themselves. Generally speaking, the results on this ship are very good, and it would seem that this scheme of ventilation and heating combined is the right one. The minor defects encountered are pointed out and remedies suggested. 7,200 words.—*United States Naval Institute Proceedings,* September.

Explosions in Diesel Engines.—Since the autumn of 1909 there have been no fewer than eighteen reported cases of breakdowns with Diesel engines, nearly all of which were due to explosion. In order to draw attention to the risk involved from explosion in this type of engine, an abstract is given of the report issued by Mr. G. S. Taylor, His Majesty's inspector of factories, on the explosion of a Diesel engine at the Bray Electricity Station in Ireland. The nature of the explosion is described and also its principal causes and the means for avoiding such a breakdown. Another instance is cited in the case of an explosion of a blast vessel, which occurred on the *Vulcanus.* It is suggested that the observance of the following recommendations would tend to reduce the risk of explosions and accidents in connection with the running of Diesel oil engines: Compressed oxygen, on account of its intense chemical affinity for combustible gases, like hydrogen, should not be used for the purpose of recharging air vessels and a warning to this effect should be issued by the makers of Diesel engines. Definite instructions should be issued by the makers with regard to the adoption of safe methods for recharging air vessels. Only competent engineers or experienced men under the direct supervision of a qualified engineer should be employed as engine attendants on Diesel plants. Traces of oil or oil vapors should be removed as far as practicable from the compressed air before it passes into the blast vessel. Air vessels, especially blast vessels, should be cleaned and examined internally as far as practicable once every twelve months. They should also be tested hydraulically once in every four years, and the amount of expansion of the vessel under the test pressure should be carefully gaged. Some device should be fitted for preventing the transmission of flame explosions along the compressed air pipes. 1,400 words.—*The Marine Engineer and Naval Architect,* December.

Cross - Channel Steamers.—The modern cross - channel steamer is in reality a miniature ocean liner, with a very high speed in proportion to her length. Her size is limited by the volume of trade she commands, which is small per ship per run. Her length is strictly limited by harbor facilities. The breadth, which for the purpose of speed should be as small as possible, is restricted to a certain minimum by the demands of stability and also by the demands of deck space for passenger accommodations. The draft is generally fixed by harbor limitations. The question of watertight subdivisions is of great importance, due to the constant presence of danger in such service. It in turn, however, is restricted by the conflicting elements of registered tonnage, upon which depend the dues and convenient passenger arrangements. The author claims that by introducing a watertight bulkhead between the engine and boiler spaces, and by making the lower deck forward, or both forward and aft, a watertight flat with watertight trunked hatches from the holds to the bulkhead deck, the watertight subdivision of the vessel would be greatly increased without affecting the tonnage measurements. Water-tube boilers have now generally superseded the cylindrical type on such vessels on account of their saving in weight, coal consumption, floor space and the time to raise steam. The system of propulsion adopted depends upon such desiderata as speed, regularity of service and, particularly, rapid maneuvering. The introduction of turbine machinery, with high-speed propellers of small diameter and with independent astern turbines of only about one-half the ahead power, has given disappointing results on account of the poor maneuvering qualities of such an arrangement, in spite of the recognized advantages of higher speeds, less vibration and saving in weight and machinery space. For this reason the various turbine reduction gears which are now being perfected offer great advantages, and the author goes so far as to claim that eventually the internal combustion engine, with its great accelerative power and other advantages which obviate the great waste accompanying intermittent full power service with steam power, will probably prove the most suitable for cross-channel work. 5 illustrations. 2,250 words.—*The Shipbuilder,* January.

Stresses in Marine Engine Shafting.—By Ernest N. Janson. This article is divided into two parts. In the first part is shown the determination of the known stresses caused by the calculable forces, as well as the plotting of curves of combined twisting moments on shafting of actual ships. No attempt has been made to establish values for the unknown stresses, but in the second part references are made to such of the forces as to which the origin of the unknown stresses may be ascribed. Critical speed of revolution is also discussed. The known stresses discussed in Part I include stresses due to forces exerted by the pressure of the steam in the various engine cylinders; stresses due to inertia of moving parts of the engine and stresses due to bending influenced in the crank shafting by direct action of steam forces, and in propeller shafting by the weight of the propeller and the pitching of the ship. The unknown stresses discussed in Part II are torsional vibration stresses; stresses brought on by distortion in alinement of bearings, either as a result of wear in the bearings or weakness of hull, or in foundations; and stresses resulting from defects in the material or running afoul and reactions of the propeller due to pitch. Frahm's experiments disclosed that maximum twisting moments in cases where actual twist of shafting had been ascertained were for three-cylinder engines 3.3 times the mean, as compared with 1.3 times obtained by the usual method of figuring. The critical number of revolutions of the fourth order of many of the engines of naval vessels often, unfortunately, constitutes the cruising speed of the ship, although the power at this speed is greatly reduced, the stress on the shafting due to the equivalent combined twisting moment, observing the above actual ratio of 3.3 ÷ 1, becomes approximately equal to shafting stresses as large as when the engine is developing full power. These stresses fluctuate between zero and the maximum value in one direction and zero and a maximum value in the opposite direction, the twisting action on the shafting being thus reversed several times during each stroke, the number depending upon the type of engine. The existence of a considerable increase of stress in shafting of reciprocating engine ships due to synchronous torsional vibration at normal or cruising speeds of naval vessels and to overload or other conditions such as constant reversal, striking of floating objects, corrosion, disalinement, etc., renders the position reasonable in assuming that shafting with a designed shear stress of 10,000 pounds per square inch of section, equivalent to probably between 14,000 and 15,000 pounds tensile stress under actual working conditions, becomes severely overstrained. This designed stress, therefore, may be lowered in the interest of greater safety, even at sacrifice of greater weight caused by increased dimensions. 11 illustrations. 9,000 words.—*Journal of American Society of Naval Engineers,* November.

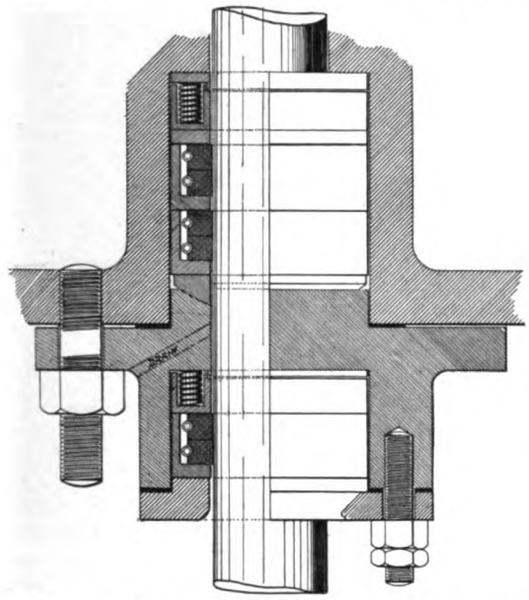
PERSONAL.—Capt. E. W. Barlow is now associated with Cox & Stevens, naval architects, New York City, in charge of their commercial vessel brokerage department, taking the place of Mr. H. Matteson, formerly with this firm.

Generated on 2024-08-12 20:26 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

ENGINEERING SPECIALTIES

Katzenstein's Improved Automatic Metallic Packing

L. Katzenstein & Company, New York, has on the market a patented improved automatic metallic cup packing, a sectional view of which is shown in the illustration. This packing is designed for use on all kinds of marine and stationary engines carrying very high pressure, and also on pumps, air compressors, etc. It is designed to hold tight against very high pressure with little friction, and also takes the vibration of the rod, and can be put in ordinary existing stuffing boxes with little change in the construction of the gland. If the metallic packing should give out, the gland is so constructed that the packing can be removed and the stuffing box repacked with fibric packing without change of gland and with little delay in the operation of the engine. A drain is provided to



carry off any condensation of steam which may occur. A metal gasket or copper rings prepared for the purpose is interposed between the gland and the stuffing box, and the gland is screwed down, making a steamtight joint. This gland carries an auxiliary stuffing box in which an additional section of metallic rings is placed for the purpose of holding back any leakage which might pass the drain.

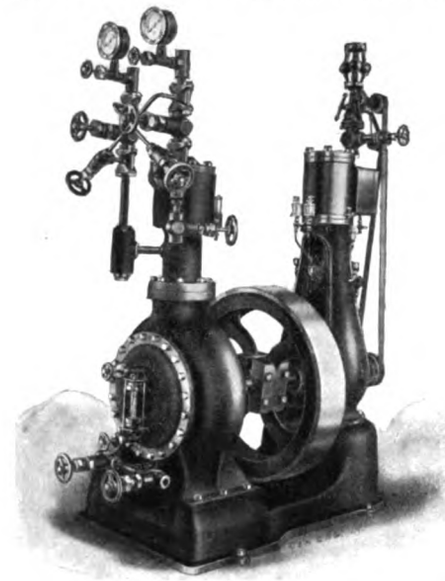
The packing consists of a series of white metal bearing rings carried in cups. At the top of the main set of packings are two rings having a spherical joint, which, it is claimed, takes up any vibration which may take place in the rod. The white metal rings are cut in three or four parts and are held in place by means of a helical spring. The hook and eye at the end of this spring are made of a special grade of steel to a special design, which, it is claimed, eliminates all danger of breaking. If the stuffing box is of sufficient depth, three cups or more of white metal rings are used. The function of the spring plate is to set the packing and make it adjustable and automatic. The last ring is to hold the spring in position and to prevent parts of springs, should they break, from coming in contact with the rod.

This packing can be constructed to suit any stuffing box. In cases where stuffing boxes are shallow the top ring might be left out and the ball ring fitted directly into the gland. The packing is practically self-adjusting, and for this reason it is made of a smaller diameter than that of the stuffing box, which gives a floating packing which will follow the rod should it vibrate or get out of center. The bearing surfaces of the rod and packing, it is claimed, will always be in the same relative positions, and hence, after the packing has once become adjusted in a box, it will retain its full bearing surface on the rod holding the same and have a steady effect upon it with very little friction.

This packing is recommended by the manufacturers for rods of 1½ inches and over.

Refrigerating Plant for Ship's Stores

It is only in the last two or three years that it has been thought possible to install a refrigerating plant on board a steamship to take care of the ship's stores. Now, however, it is possible to equip a steamship, no matter how small or how large, with a refrigerating plant to cool the ship's stores' refrigerator or refrigerators, to make any amount of ice needed, and to cool water for drinking, all with one machine. The Brunswick Refrigerating Company, New Brunswick, N. J., has installed over two hundred machines on steamships for



this purpose, and in a few cases entire cargo holds are being refrigerated.

In the machine used for this work the ammonia compressor is direct connected to an engine of the vertical center-crank type. The compressor has an eccentric in the crank case and this eccentric and the strap which works on it, it is said, have shown no appreciable wear, even after ten years of service. This machine, together with the ammonia condenser and other apparatus used in connection with the machine, can be placed near the refrigerators, if there is room, or at some distance from them, if there is no room near the refrigerators. In a recent case pipes were run from the machine, placed amidships in the engine-room, through the shaft alley to the refrigerators, which were on the main deck aft, a run of over 200 feet each way. The ice-making apparatus can be installed near the refrigerators or near the machine, just whichever is more convenient. Cooling coils are placed in the refrigerator, and all the dirt and muss of ice is avoided, as no ice is placed in the refrigerator.

These plants, it is claimed, have proved a means of securing very great savings on the ships on which they have been installed. In one case a sufficient amount of meat, butter and eggs and vegetables was taken aboard in New York to last during a 69-day trip to the upper Amazon and back. With a Brunswick plant these goods were kept in perfect condition during the entire trip and the material served on the day the steamer arrived in New York was just as good as that served the day the steamer left. Such plants can be used advantageously for preserving the ship's stores on any type of vessel, whether it is a steamer, a dredge, a collier, an oil tanker or a yacht.

Generated on 2024-08-12 20:26 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

"Bisset" Adjustable Folding Canvas Chair

The deck chair illustrated, which is the invention of Naval Constructor G. A. Bisset, U. S. N., Portsmouth, N. H., can be adjusted as an ordinary upright-back chair, or it may be placed in a position in which the back and leg rest are almost horizontal. It can also be adjusted to any one of several intermediate positions.

The chair is extremely comfortable, as the head comes in contact with the canvas only, and not with the wood, as it

does with the usual type of steamer chair. The back of the chair has a curved wooden brace, which is entirely clear of the canvas, and the canvas can be removed and replaced quickly, a feature which permits the canvas to be scrubbed whenever it becomes dirty. The chair can be folded compactly into a very small space when it is desired to stow it away.

A patent for this construction has been applied for.

Special Types of Lunkenheimer Pop Safety Valves

The use of large-size pop-valves is in a number of cases not only objectionable, but in some cases a pop-valve above five inches is prohibited. It is therefore necessary to use two smaller valves having a combined area equal to that of the required large-size valve, and for this reason the constructions shown in Figs. 1 and 2 were designed by the Lunkenheimer Company, Cincinnati, Ohio. Fig. 1 illustrates the

Fig. 1

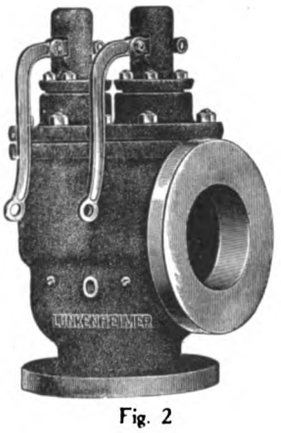


Fig. 2

"Twin" pop-valve, which merely consists of two separate valves attached to a suitable base or Y, while Fig. 2 shows the "Duplex," in which two independently operating valves are encased in one body. Both have their advantages. With the "Twin," should one of the valves become damaged beyond repair it can be replaced with a new valve at a less cost than the "Duplex." On the other hand, space may not permit of the use of the "Twin," and, consequently, the "Duplex" must be resorted to. In some cases no objection is had to the escaping steam within the boiler room, and, therefore, no pipe connection is made to the outlet. Should it be desired to have the steam exhaust at a distance from the valve, the "Duplex" would then have the advantage, inasmuch as only one pipe connection is necessary, whereas the "Twin" would require two.

Fig. 3 illustrates a type of valve generally known as the "Marine" pattern. It differs from the "Sentinel" pop-valve described in the January issue only in the addition of a wing handle at the top of the valve, the object of which is to conveniently enable the turning of the disk on its seat for regrind-

Fig. 3

Fig. 4

ing purposes, or while the valve is under pressure to remove slight incrustations that may lodge on the seating surfaces.

An improved form of valve that is very popular is that shown in Fig. 4. In this construction the spring is exposed, the principal advantages being that the spring is positively protected from the steam and that it is at all times accessible for inspection. This valve is particularly well adapted for use where superheated steam is used, as the extremely high temperatures cause the springs to rapidly lose their tension. The construction of the working parts is practically the same as the "Sentinel" valve, shown in the January issue.

Trials of a 100 Brake Horsepower Junkers Marine Oil Engine

The Maschinebau Actiengesellschaft vorm. Gebr. Klein in Dahlbruch recently delivered a Junkers marine oil engine of 100 brake horsepower, of a type which has been specially developed for the purposes of inland navigation.

The advantages of the Junkers engine for inland navigation work, as compared with four-cycle and other two-cycle engines, are set forth by Professor Junkers as follows:

(a) Low weight, therefore shallow draft.

(b) Simple design, therefore simple attendance, which is of importance respecting the incompetent personnel often found on rivers and canals.

(c) Absence of parts, which are frequently the cause of breakdowns, i. e., scavenging valves, exhaust valves and cylinder covers.

(d) Good balancing and light load on main bearings, therefore minimum wear and no overheating.

(e) Low fuel consumption, therefore low running costs.

(f) Small initial cast.

Description of the Engine

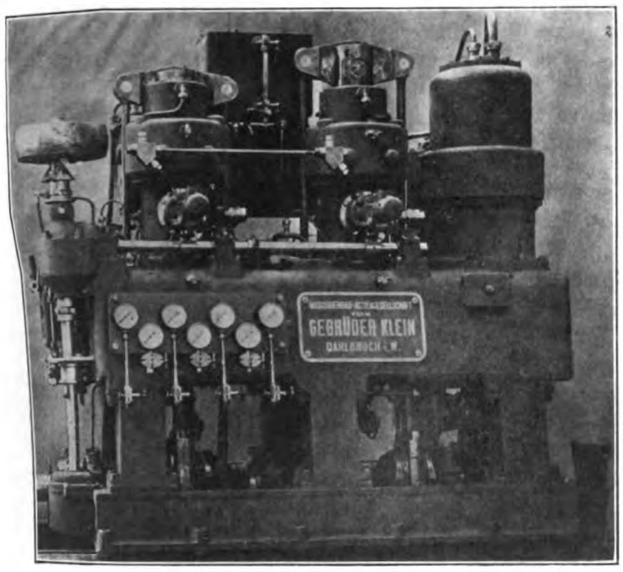
The engine has an output of 100 brake horsepower at 300 revolutions per minute. The two working cylinders and the scavenging pump are supported on and connected by a con-

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

tinuous scavenging air receiver. Both cylinders exhaust into one exhaust box, arranged horizontally at the rear of the cylinders. The scavenging air is delivered at a pressure of 2.2 to 2.9 pounds per square inch, the scavenge pump being driven directly off the crank shaft by a crank and connecting rod. Compressed air for the injection of the fuel oil and for starting the engine is supplied by a simple acting three-stage compressor, the second stage of which is placed on top of the scavenge pump, the first and third stages being arranged at the rear of the scavenge pump.

Each cylinder is fitted with a fuel valve, a starting valve and a safety valve.

The two fuel valves are actuated by a cam shaft running horizontally along the top of scavenging air receiver and connected by gearing to the crank shaft. The cam shaft has been



placed so close to the fuel valves that a single light lever suffices to make the connection between the cam and the fuel valve needle. The inertia effect is thus reduced to a minimum. The arrangement, it is claimed, can be adjusted with the greatest precision while the engine is running.

The starting gear is provided with an arrangement designed to prevent any fuel from entering the cylinders while the engine is starting up on compressed air.

The fuel pump is fixed to the scavenging air receiver at the flywheel end. It is driven by means of a crank in the vertical shaft connecting the cam shaft to the crank shaft. By means of a double lever both pistons are driven off the same crank. The lever also works the rods of the suction valves.

Governing of the fuel supply to the requirements of the load is effected by varying the length of time that the suction valve is open during the pressure stroke of the fuel pump. The speed of the engine can be controlled independently of the governor, directly from the running platform or the bridge, by varying the lift of the suction valve.

Seven pressure gages are arranged on the front of the scavenging air receiver; two of these are connected to the starting air bottles and two to the compressor receivers; the others register the pressure of the injection air, scavenging air and cooling water, respectively.

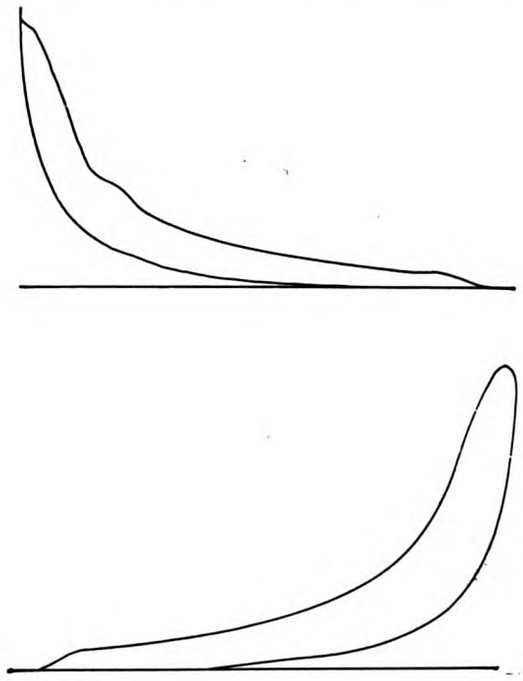
At the front end of the engine are arranged a circulating pump and a bilge pump, both directly driven by the main engine.

STARTING THE ENGINE

After having made certain that the fuel supply pipe is filled with oil up to the fuel valves, also that the valves connecting the air bottles to the starting airline are open, the only movement required to start the engine is to push over the starting lever to "starting" position, thus admitting compressed air to the cylinders, and after a moment, usually after two or three revolutions, the starting lever is returned to the "running" position and the engine continues to run normally on oil. Thus the whole operation of starting consists in moving a single lever once forward and back again.

THE TRIALS

The acceptance trials required by the purchasers were run by Professors Laas and Romberg, of Technical High School, Charlottenburg, on the test bed at Dahlbruch. A 72-hour continuous trial was stipulated. The engine ran without stoppage, except for a very short time in consequence of a necessary



alteration to the testing brake, for a period of 60 hours, further trial being deemed unnecessary on account of the satisfactory results obtained.

During the trial two hours were run at 10 percent overload, which was carried by the machine in a perfectly satisfactory manner. The mean fuel consumption was .407 pounds per brake horsepower hour at the normal load of a 100 brake horsepower. The maximum output obtained was about 120 brake horsepower.

Powell "Mac" Compression Grease Cup

The Powell "Mac" automatic grease cup, manufactured by the Wm. Powell Company, Cincinnati, Ohio, is especially designed for general all-around use. It is cast of brass sufficiently heavy and well proportioned, and operates equally well on cranks, crossheads, slides and journals of all kinds, meeting the demand for a simple, easily operated, reliable compression grease cup. The plunger, or piston, has a leather packing, insuring a snug fit and preventing the grease from backing up and filling around the spring and thus interfering with its operation. It has a simple feed adjustment, and an automatic lock arrangement, which it is claimed precludes any possibility of the feed being cut off by vibration or jarring of the machinery.

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

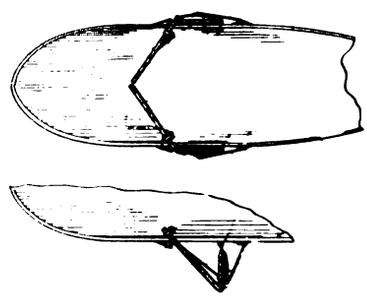
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Millertown, N. Y.

1,078,902. VESSEL EMERGENCY-BRAKE. SAMUEL S. CENTOFANT, OF SMITHS BASIN, N. Y.

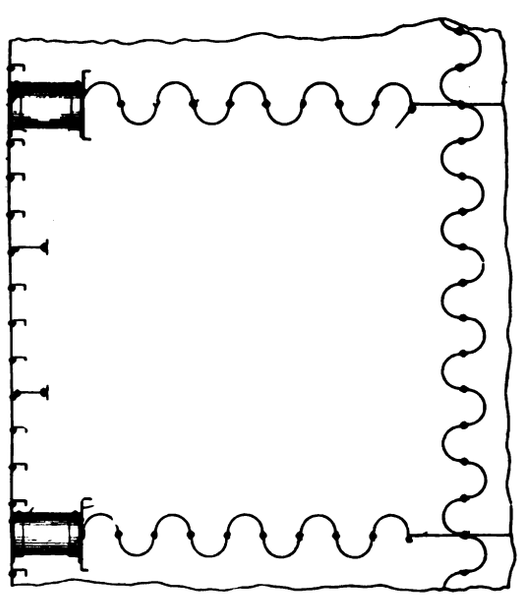
Claim.—In a brake mechanism for vessels, the combination of a hull, a leaf pivotally mounted on the side of the hull with its axis of rotation disposed vertically with respect to the hull, means for swinging said leaf to positions against and at an angle to the hull and means for bracing the leaf when the latter is disposed substantially at right



angles to the hull, said means comprising an arcuate rod disposed transversely of the leaf and having its terminals secured thereto, a U-shaped bracket secured to the hull and disposed longitudinally of the latter, and a brace rod having its terminals slidably engaged with the arcuate rod and bracket, respectively. One claim.

1,076,208. SYSTEM OF CONSTRUCTION FOR STEEL SHIPS. SAMUEL HOLMES, OF ELIZABETH, N. J.

Claim 1.—A bulkhead construction for ships involving a main longitudinal central bulkhead and transverse bulkheads connected therewith and with the sides of the hull by a bulkhead frame construction com-



posed of sheet metal formed into deep undulations or trough-shaped members which open in opposite directions and which are riveted to the hull, and between which and the bulkheads are placed web plates which are riveted thereto and to said bulkheads. Seven claims.

1,076,295. SINKING DEVICE FOR AUTOMOBILE TORPEDOES. FRANK M. LEAVITT, OF SMITHTOWN, N. Y., ASSIGNOR TO E. W. BLISS COMPANY, OF BROOKLYN, N. Y., A CORPORATION OF WEST VIRGINIA.

Claim 3.—In an automobile torpedo, a spring-closed exhaust-valve opening from an air chamber within the shell, and means for holding said valve open when it has been opened by the escaping air consisting of a spring-pressed dog engaging the rim of the valve and adapted to spring between it and its seat upon the opening of the valve. Six claims.

1,079,182. SUBMARINE CULTIVATOR AND HARVESTER. NELS A. LYBECK, OF BRISTOL, R. I.

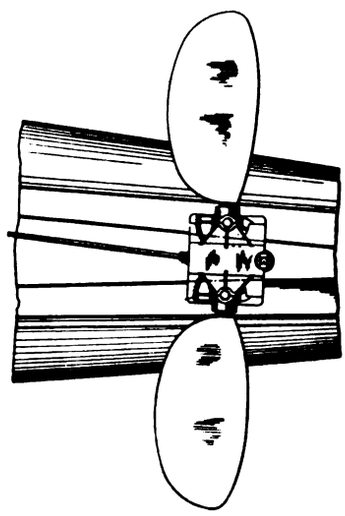
Claim 1.—In a submarine cultivator and harvester, a submarine tool having a lateral extension adapted to travel on the sea bottom; a floating vessel; a cradle mounted on said vessel from which said tool is operated; a boom pivotally connected with said cradle and said tool; a conveyer mounted on said boom, and a cover for said conveyer mounted on said boom to receive water pressure for depressing the tool bearing end thereof, when the device moves forward. Seven claims.

1,073,954. MARINE STEERING-GEAR. LESLIE CAULDWELL BURNS, OF UNION HILL, N. J., ASSIGNOR OF ONE-HALF TO CYRUS J. WALTERS BURNS, OF NEW BRUNSWICK, N. J.

Claim 1.—A motor for actuating steering gear, comprising a fluid pressure cylinder, a piston working therein, a piston rod extending beyond each end of the cylinder to afford means for an operative connection to a rudder, inlet and outlet valves opening to each end of the piston cylinder, and a geared disk, connecting rods therefrom to each of said valves and a manually controlled pinion for rotating said disk to simultaneously actuate said valves. Six claims.

1,073,100. FOLDING HYDROPLANE FOR SUBMERSIBLE BOATS. GREGORY CALDWELL DAVISON, OF QUINCY, MASS.

Claim 3.—A submarine or submersible boat, having hydroplanes swiveled thereon on vertical axes, whereby they may be turned in a

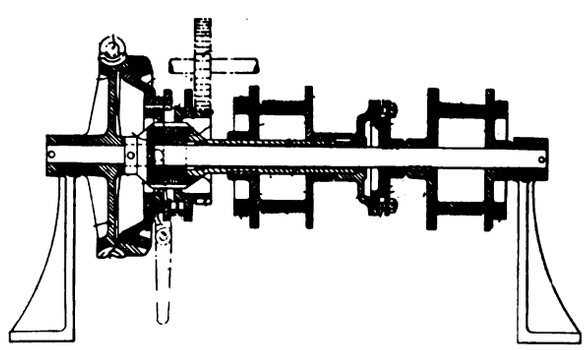


lateral sweep from an extended position of wide spread to a shipped position lengthwise of the boat, in combination with mechanism for adjusting the hydroplanes on their horizontal axes for steering. Seventeen claims.

British patents compiled by G. E. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

1656/1913. BOAT-HOISTING AND LOWERING GEAR FOR SHIPS. M. E. DENNY, OF LEVEN SHIPYARD, DUMBARTON, N. B.

Claim.—The invention consists essentially in the interposition between the usual falls in boat-hoisting and lowering gear and the operating means of a three-member epicyclic train, one member of which is connected with one fall, another to the other fall, and the intermediate member to operating mechanism, the object being to automatically

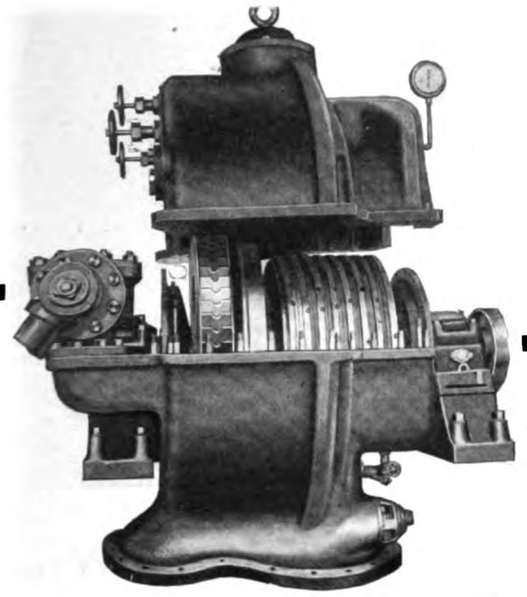


maintain an even keel. The falls are led to two winding drums, one fast on a shaft, the other fast on a sleeve loose thereon. To the drums are connected to two large bevel pinions of the epicyclic train and the planetary bevel pinions engaging these and carried in a spider free on the shaft. To the spider is applied the operating gear and a brake. The falls are attached to the boat at points horizontally equidistant above its center of gravity.

22923/1912. APPARATUS FOR LOWERING SHIPS' BOATS. THE MARTIN PATENT DAVIT COMPANY, LTD., OF 9 UNION COURT, LIVERPOOL, AND E. S. GLADSTONE.

Same.—The object of this invention is to enable ships' boats to be lowered on an even keel when the ship is down by the head or stern. The end of the rope of the falls instead of being fixed is led, for example, to a barrel capable of being rotated and locked in any position. The barrel is operated by a worm and worm wheel which are self-locking. By turning the barrel rope is wound upon or wound off from it, thus shortening or lengthening the fall relatively to the other fall and compensating for the inclination of the ship. The well-known Martin davits, in which the same rope is used for both falls, is preferably used.

Generated on 2024-08-12 20:32 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN



Air Cannot Leak
Into the Condenser

of the new Terry Condensing Turbine. The vacuum end is placed near the high-pressure stage, thus leaving steam at atmospheric pressure against the only gland exposed to vacuum. The steam, upon leaving the multi-velocity high-pressure stage, travels to the other end of the casing, and comes back through the low-pressure stages. Any leakage through the vacuum gland or stuffing box must be pure steam from the high-pressure stage. Under no circumstances can air leak into the condenser of the **Terry**

RETURN FLOW TURBINE

Other features, each of which had its part in the steady advance of the Terry, are a multi-velocity high-pressure stage (the well-known Terry wheel); **second,** multi-pressure impulse elements at the low-pressure end; **third,** bearings supported on pedestals—no change in alinement; **fourth,** casings hung from bearing housings—no change in alinement between case and shaft—radial expansion; **fifth,** entire rotating element, including stationary vanes, is removable without disturbing steam or exhaust connections (lifted out with the shaft).

For further description see November number, page 501.

Send today for interesting literature on **Terry Turbines** for marine uses.

Horizontal: 5 to 1000 H. P.
Vertical: 5 to 600 H. P.

The Terry Steam Turbine Co.

Main Office and Works:
HARTFORD, CONN.

British Agents: - YARROW & CO., Ltd.
Scotstown, Glasgow

Agencies in all Principal Cities. 32-210

TRADE PUBLICATIONS.
AMERICA

The Dexter valve reseating machine is described in circular I-16, published by the Leavitt Machine Company, Orange, Mass. "You can prove to your entire satisfaction the actual saving which can be made by reseating your pump valve seats with an improved Dexter pump valve machine. Count the stroke of your pump for five minutes. Then reface the seats with a Dexter machine. Then count the stroke again for five minutes. You'll find the saving to be 15 percent to 35 percent, an economy which will soon pay for the machine which does this work. The taking out of a worn valve seat is a tedious and expensive process. Oftentimes the seats are so securely seated in rust that a hammer and cold chisel are required to take them out. In the manufacture of pumps the valve seats are driven or screwed into position with sufficient force to cause the several portions of circumference between the ribs to bulge, making as many high spots on the valve face as there are bars in the valve seat. It matters not how true the seat may be before driven, it must be recut to an accurate surface before you can have a tight valve which is absolutely essential for pump efficiency. Several pump manufacturers are using Smith & Williams patent cutters for truing valve seats before the pumps leave the factory."

"Fire Tragedies of the Sea, and How They Can be Averted by Automatic Sprinklers," is the title of the leading article in the January number of the Grinnell Automatic Sprinkler Bulletin, published by the General Fire Extinguishing Company, Providence, R. I. "The burning of the *Volturno* at sea, with a loss of a hundred and thirty-six lives; a fire on one of the giant ocean liners, which cost two lives, and the thrilling rescue of hundreds of passengers from the burning *Balmes* have riveted public attention upon the fire danger existent in ships. Suddenly, like a spectre, this hazard of ocean travel has reared itself, and the public has gasped in fear and astonishment. Fear there should be, but astonishment, not at all! Just one year ago this bulletin quoted Capt. Richard Pearson Hobson as prophesying a calamity similar to the *Volturno* burning. Capt. Hobson knew whereof he spoke. He had studied the matter. He knew the conditions. He knew the leviathans of the ocean were being built for luxury rather than safety. Nor was his word the only warning. The record of marine fires was more than sufficient to forewarn the world that fire would continue to claim its toll at sea, just as it is almost daily claiming it on land. More than 6,000 people have lost their lives in marine fires. In the last seven and a half years 155 ships have burned completely and about 2,500 partially. Throughout the world one steam vessel has burned wholly or in part every day for seven and a half years. When ships are burning at this rate, the inexorable law of average will now and then add human life to the sacrifice. And the pity of the condition is its uselessness. There may be grave questions about making boats collision-proof, but there is no question about making them fireproof. The same device that has made many hazardous cotton mills and manufacturing plants in this country immune from fire danger will safeguard the ships of the sea. That device is the automatic sprinkler. After the *Imperator* fire it was stated that automatic sprinklers could not be successfully installed on such a boat. The statement was erroneous. One of our engineers carefully surveyed the *Imperator* and found that skillful engineers would have no difficulty in equipping it with automatic sprinklers. That such fire protection will do for ships what it has done for buildings is the consensus of opinion among insurance and fire protection experts. That means that fire danger on ships can be reduced more than 95 percent. In fact, automatic sprinklers seem peculiarly adapted for use on shipboard, for here one of the chief difficulties in fighting fire is that the blaze is often far down in the depths of the vessel in some cargo-filled compartment. Out of the narrow hatchway come flame and smoke. The only way to put out the fire is to down it out, and because they don't know where the heart of the fire is, and because they could not get at it if they did, men must practically fill the whole compartment with water. *Safety Engineering* is responsible for the statement that 'it took 2,000,000 gallons of water to put out the fire in the provision hatchway of the *Imperator;* 10,000 times more than would have been required with automatic sprinklers.' The reason for this statement is that had an automatic sprinkler been there it would instantly have felt the heat from even a trivial blaze and begun at once to pour its water directly into the heart of the fire. Just how completely sprinklers safeguard every part of a boat may be seen from the plan of the equipped freighter *Pequannock* shown opposite."

When writing to advertisers, please mention INTERNATIONAL MARINE ENGINEERING.

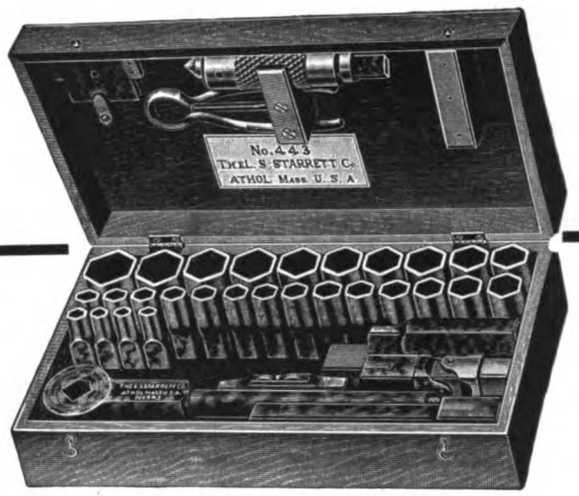
Generated on 2024-08-12 20:33 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Inclined elevators — continuous motion carriers — which meet every condition of freight transportation from level to level, and which are particularly adapted to the quick and economical handling of freight on steamship docks and piers, and in storage warehouses, freight stations, etc., are described in a catalogue published by the Otis Elevator Company, Eleventh avenue and Twenty-sixth street, New York. Without obligation of any kind the Otis Elevator Company's engineering department will submit plans and estimates of equipment and operation cost of the types best adapted to your requirement. The company states, "Put your freight-moving problems up to us—we offer you a real help and a positive solution."

The J. M. Dodge Company, Nicetown, Philadelphia, Pa., has issued a 100-page catalogue, fully illustrated, which calls attention to "The Dodge System." This is stated to be the most successful application of engineering practice for the storage of anthracite coal. One of the illustrations in this catalogue shows an electrically-operated traveling direct-unloader on the pier of the New York Central & Hudson River Railroad at Weehawken, N. J. This is fitted with movable booms, and is equipped with independent hoisting and trolleying machines for each boom, arranged for operating a 40-cubic foot self-filling bucket for handling coal, ore, sand, sulphur, etc., or it may be equipped with hanging blocks for handling 5-ton or 10-ton loads of miscellaneous materials. Both booms may be operated simultaneously or independently. All operations are performed by alternating-current motors.

Type H cranes are described in Bulletin No. 401, just published by the Pawling & Harnischfeger Company, Milwaukee, Wis. "Liability laws in force and under enactment by various States will place a greater liability burden for accidents in manufacturing establishments directly upon the employers. Ample protection, and to the extent of installing machinery with the most approved safeguards, has become a primary consideration. In designing our new type H crane these conditions and demands have been kept in view, with the result that we have developed a crane as safe, serviceable and durable as can be made consistent with good crane operation. Rugged construction, no over-hung and entirely enclosed gears, and the most approved design of all wearing parts, are the most important points, but the following list of salient features will give a very clear idea of just how this latest and newest addition to the P & H line differs from practically all other cranes on the market."

Metallic packing is the subject of a catalogue just published by L. Katzenstein & Company, 358 West street, New York. A copy of this catalogue will be sent free to any of our readers upon request, and one should be in the hands of every engineer, shipbuilder, naval architect and steamship owner. "The great advance made in steam engine practice during recent years has created new and increasing demands upon engine builders. In order to keep pace with these demands new engine accessories have become essential. Upon no other engine auxiliary have these new requirements been more severe than upon packings. In this feature, however, we can say with pride that our packings have advanced with the pace of modern engines. Mr. L. Katzenstein, head of the firm of L. Katzenstein & Company, is one of the earliest pioneers in the manufacture of metallic packings. He has had a continuous practical experience in this line since 1870, and at no time in his career have the metallic packings produced by this firm been surpassed, or even equaled, by any other house. Many have attempted, though unsuccessfully, to introduce imitations of Katzenstein's metallic packings. Some of these imitations are infringements upon our former and present packings, yet in spite of such infringements our business has materially increased each year—the best proof of our skilled workmanship as well as our reasonable prices and careful attention to details on all orders. Katzenstein's metallic packings are known and used in every part of the world. They are recognized not only as the best but the most economical as well. Hosts of engine builders, owners and steamship companies have continued to patronize us, exclusive of all others, since the establishment of this house. The following characteristics sum up the points of superiority of Katzenstein's standard metallic packing over other packings of a similar nature: 1. It requires no alteration of stuffing-boxes; the packing is made to suit the boxes. 2. It gives a perfectly tight stuffing-box with a steadying effect upon the rod or stem and with little friction. 3. It will last for many years—an assertion which can be verified by many responsible engineers. 4. It keeps the rods and stems perfectly smooth and requires but little lubrication. 5. It will not corrode the rod when the engine is not in use."



You're never cornered with a

Starrett Patent Ratchet Wrench

On board ship where machinery is cramped and in dark places you will find this tool a wonder. It will turn out any standard nut or bolt in all sorts of difficult places—places where the ordinary monkey wrench is useless. The ratchet permits rapid action with only a short arc swing. The extension reaches into otherwise inaccessible places.

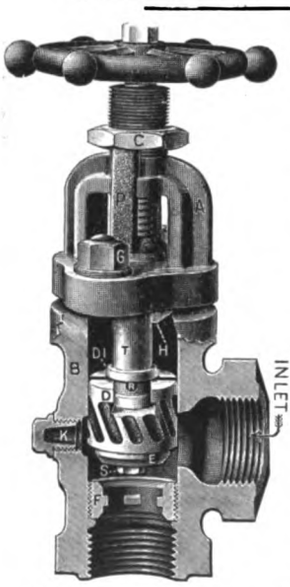
Send for Catalog No. 20L.

THE L. S. STARRETT CO., Athol, Mass.

42-59

POWELL VALVES

(Especially The "White Star" Valve)



The Powell "Cyclone" Blow-Off Valve

Won't Choke Up

No matter how muddy the water may be or how much scales passes out with the water. Everything must go out with the water and steam.

The plunger is grooved to scrape off anything that might adhere to the sides of the body, and the bevel on the seat prevents anything from lodging on it. All working parts are renewable.

Ask your dealers for "Powell Valves" or write us.

THE WM. POWELL CO.

DEPENDABLE ENGINEERING SPECIALTIES.

CINCINNATI O.

5

Generated on 2024-08-12 20:25 GMT / https://hdl.handle.net/2027/mdp.39015007003521
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN